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TERM - I

VOLUME - 2

MATHEMATICS

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Untouchability is Inhuman and a Crime

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Mathematics is a unique symbolic language in which the whole world works and acts accordingly. This text book is an attempt to make learning of Mathematics easy for the students community.

Mathematics is not about numbers, equations, computations or algorithms; it is about understanding

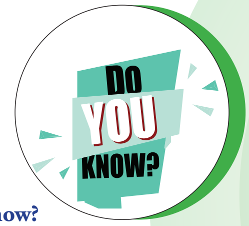
— William Paul Thurston

To enjoy learning Mathematics by doing

Activity

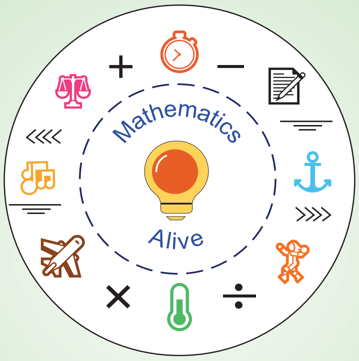
Try this/these

A few questions which provide scope for reinforcement of the content learnt.



Do you know?

To know additional information related to the topic to create interest.



Think

To think deep and explore yourself!

To understand that Mathematics can be experienced everywhere in nature and real life.

Miscellaneous and Challenging problems

To give space for learning more and to face higher challenges in Mathematics and to face Competitive Examinations.

Note

To know important facts and concepts

ICT Corner

Go, Search the content and Learn more!

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E - Book

Evaluation

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Chapter 1

NUMBERS

Learning Objectives

- To understand large numbers and the terms used to represent them.
- To compare large numbers and order them.
- To employ estimation for large numbers.
- To solve word problems involving four fundamental operations.
- To understand and use the properties of Whole Numbers.

1.1 Introduction

Read the following conversation between two classmates.

Mani : (Reading Newspaper Headlines)
"Ten thousand people visited the trade fair yesterday".

Mallika : Wow! That's a lot of people.

Mani : Thank goodness, I went to the trade fair exactly yesterday!

Mallika : Why... what is so important about it?

Mani : Don't you see? If I had not gone, they would have written "Nine thousand nine hundred and ninety-nine people only visited the trade fair yesterday". It would have been difficult to read and understand!

What do you think about this conversation? Was Mani right?

No! it would still be "Ten thousand people visited!". Newspapers give (and readers want) a sense of the size, NOT exact values when numbers are large.

You have probably heard names like 'lakhs' and 'crores' used by elders.

We often come across situations that involve large numbers in real life, like the number of people living in a district, the budget of the Government, the distance of stars or the number of bicycles sold in a year and so on. In all these situations, we look for names that convey the "size" of these numbers.

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MATHEMATICS ALIVE - LARGE NUMBERS IN REAL LIFE

Tamil Nadu has about 26,345 square kilometre of forest land.

The number of stars in the Milky way galaxy is about 20,000 crore

Let us understand the large numbers in detail, and the way they are connected to the numbers learnt earlier.

Recap of Successor and Predecessor

- When 1 is added to a number we get its Successor.
- When 1 is subtracted from a number we get its Predecessor.

TRY THESE

- 999 + 1 = _________.
- 10000 − 1 = _________.
- The Successor of 4576 is __________.
- The Predecessor of 8970 is _________.
- The predecessor of the smallest 5 digit number is _________.

1.2 Formation of large numbers

Now, we learn the formation of large numbers. Let us build and complete the number tower by observing the pattern of numbers.

Greatest number	Add	Equals	Smallest number	Number Name
Greatest 1 digit number 9	+ 1	=	Smallest 2 digit number 10	Ten
Greatest 2 digit number 99	+ 1	=	Smallest 3 digit number 100	Hundred
Greatest 3 digit number 999	+ 1	=	Smallest 4 digit number _______	Thousand

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Greatest 4 digit number ________	+ 1	=	Smallest 5 digit number 10000	Ten Thousand
Greatest 5 digit number ________	+ 1	=	Smallest 6 digit number ________	Lakhs
Greatest 6 digit number ________	+ 1	=	Smallest 7 digit number ________	Ten Lakhs
Greatest 7 digit number 9999999	+ 1	=	Smallest 8 digit number 10000000	Crores

We can observe that in every row the smallest number column has an additional zero compared to the previous row. You have read in lower classes about place value system. In this system (which was invented in India and spread to other countries!), the number 10 plays a very important role. It is shown in the following table.

1×10	=	10	(Ten)
10×10	=	100	(Hundred)
100×10	=	1000	(Thousand)
1000×10	=	10000	(Ten Thousand)
10000×10	=	100000	(Lakhs)
100000×10	=	1000000	(Ten Lakhs)
1000000×10	=	10000000	(Crore)

While each new row gives a number 10 times bigger, what happens if we skip and go 2 rows below. Numbers would be 100 times bigger.

For example, 1000 = 100 times 10, or Thousand has "hundred tens" in it.

NOTE

As the numbers get large, it is difficult to keep track of the number of digits and the place value for each digit. Wherever possible, we use names like lakh and crore instead of writing so many zeros. However, we can write exact values of large numbers too, if needed.

TRY THESE

1. Give 3 examples where the number of things counted by you would be a 5 digit number or more.
2. There are ten lakh people in a district. What would be the population of 10 such districts?
3. The Government spends rupees 2 crores for education in a particular district every month. What would be its expenditure over 10 months?

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1.3 Place Value Chart

1.3.1 Indian Method

Periods	Crores		Lakhs		Thousands		Ones		
	TC	C	TL	L	T Th	Th	H	T	O
Place Value	Ten Crores	Crores	Ten Lakhs	Lakhs	Ten Thousands	Thousands	Hundreds	Tens	Ones

When we write large numbers we make use of place value chart to ensure that we do not miss any digit in between, while writing it. In a given number, starting from the right, the first three places make the ones period, the next two places make the thousands period, the next two places make the lakhs period and the next places make the crores period.

Try to read the number 359468421. Is it difficult? Yes. It is not easy. But by using the indicators or the periods, it is easy to read and write 359468421 as under.

Periods	Crores		Lakhs		Thousands		Ones		
Place Value	TC	C	TL	L	T Th	Th	H	T	O
Number	3	5	9	4	6	8	4	2	1
Number Name	35 Crores		94 Lakhs		68 Thousands		421 Ones		
	Thirty five crore ninety four lakh sixty eight thousand four hundred twenty one.								

Use of comma

In any given number, we separate the periods by using commas. In our Indian System of Numeration, we use commas from the right. The first comma comes before Hundreds place (3 digits from the right). The second comma comes before Ten Thousands place (5 digits from the right). The third comma comes before Ten Lakhs place (7 digits from the right) and the digits next to it represents crore.

Example 1.1

The distance between the Sun and the Earth is about 92900000 miles. Read and write the number in the Indian method.

Solution

Periods	Crores	Lakhs		Thousands		Ones		
Place Value	C	TL	L	T Th	Th	H	T	O
Number	9	2	9	0	0	0	0	0
Using Commas	9,29,00,000							
Number Name	Nine crore twenty nine lakh.							

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TRY THESE

Complete the table

Place Value / Number	TC	C	TL	L	T Th	Th	H	T	O	Number name
1670										
47684										
120001										
7800500			7	8	0	0	5	0	0	Seventy Eight Lakh Five Hundred
53409098										
198765912										

Note: When we write numbers, the place value increases from right to left.

1.3.2 International Method

This system is followed by many countries in the world.

Periods	**Billions**			**Millions**			**Thousands**			**Ones**		
	HB	**TB**	**B**	**HM**	**TM**	**M**	**HT**	**T Th**	**Th**	**H**	**T**	**O**
Place Value	Hundred Billions	Ten Billions	Billions	Hundred Millions	Ten Millions	Millions	Hundred thousands	Ten Thousands	Thousands	Hundreds	Tens	Ones

In a given number, starting from the right, the first three places make the ones period, the next three places make the thousands period, the next three places make the million period and the next three places make the billion period etc.

Read and write 35694568421 in the international method

Periods	Billions			Millions			Thousands			Ones		
Place Value	HB	TB	B	HM	TM	M	HT	T Th	Th	H	T	O
Number		3	5	6	9	4	5	6	8	4	2	1
Number Name	35 Billions			694 Millions			568 Thousands			421 Ones		
	Thirty five billion six hundred ninety four million five hundred sixty eight thousand four hundred twenty one.											

Use of commas

In the International System of Numeration, we use Ones, Tens, Hundreds, Thousands, Ten Thousands, Hundred Thousands, Million, Ten Million, Hundred Million and Billion, Ten Billion, Hundred Billion. Commas are used to mark Thousands, Millions and Billions.

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Example 1.2

The distance between the Sun and the Earth is about 92900000 miles. Read and write the number in the International Method.

Solution

Periods	Billions			Millions			Thousands			Ones		
Place Value	HB	TB	B	HM	TM	M	HT	T Th	Th	H	T	O
Number					9	2	9	0	0	0	0	0
Using Commas	92,900,000											
Number Name	Ninety two million nine hundred thousand.											

1.3.3 Comparison of Number Systems

We can easily understand both the Indian and the International Number Systems from the following table.

Indian Number System			International Number System		
Period	Name	Numeral	Name	Numeral	Period
Ones	One	1	One	1	Ones
	Ten	10	Ten	10	
	Hundred	100	Hundred	100	
Thousands	Thousand	1,000	Thousand	1,000	Thousands
	Ten thousand	10,000	Ten thousand	10,000	
Lakhs	Lakh	1,00,000	Hundred thousand	100,000	
	Ten Lakh	10,00,000	Million	1,000,000	Millions
Crores	Crore	1,00,00,000	Ten Million	10,000,000	
	Ten crore	10,00,00,000	Hundred Million	100,000,000	
	Hundred crore	100,00,00,000	Billion	1,000,000,000	Billions
	Thousand crore	1000,00,00,000	Ten Billion	10,000,000,000	

With the help of the above table, we can read the number 57340000 as 5,73,40,000 (Five Crore Seventy Three Lakh Forty Thousand) in the Indian System and as 57,340,000 (Fifty Seven Million Three Hundred Forty Thousand) in the International System.

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TRY THESE

Identify the incorrectly placed comma and rewrite correctly.

Indian System : (i) 56,12,34,0,1,5 (ii) 9,90,03,2245

International System : (i) 7,5613,4534 (ii) 30,30,304,040

ACTIVITY

Take a white chart and cut into 9 equal pieces. Write different numbers on each piece. Arrange the pieces, as many times, horizontally which form different numbers. Write any five different numbers and express them in the Indian and the International System.

1.3.4 Place Value of digits in Large Numbers

Every digit of a number has a place value which gives the value of the digit.

Write the number 676097 in expanded form:

Number : 6,76,097

Expanded form : 6 lakhs + 7 ten thousands + 6 thousands + 0 hundreds + 9 tens + 7 ones

: $6 \times 100000 + 7 \times 10000 + 6 \times 1000 + 0 \times 100 + 9 \times 10 + 7 \times 1$

: $600000 + 70000 + 6000 + 90 + 7$

Finding the place value of all the digits in 9847056:

The Place value of 6 is	=	6 Ones	=	6×1	=	6
The Place value of 5 is	=	5 Tens	=	5×10	=	50
The Place value of 0 is	=	0 Hundreds	=	0×100	=	0
The Place value of 7 is	=	7 Thousands	=	7×1000	=	7,000
The Place value of 4 is	=	4 Ten Thousands	=	4×10000	=	40,000
The Place value of 8 is	=	8 Lakhs	=	8×100000	=	8,00,000
The Place value of 9 is	=	9 Ten Lakhs	=	9×1000000	=	90,00,000

Hence, the number 98,47,056 is read as Ninety Eight Lakh Forty Seven Thousand Fifty Six.

TRY THESE

1. Expand the following numbers:
   (i) 2304567 (ii) 4509888 (iii) 9553556
2. Find the place value of underlined digits.
   (i) $3\underline{8}41567$ (ii) $94\underline{4}3810$
3. Write down the numerals and place value of 5 in the numbers represented by the following number names.
   (i) Forty Seven Lakh Thirty Eight Thousand Five Hundred Sixty One.
   (ii) Nine Crore Eighty Two Lakh Fifty Thousand Two Hundred Forty One.
   (iii) Nineteen Crore Fifty Seven Lakh Sixty Thousand Three Hundred Seventy.

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Example 1.3

How many thousands are there in 1 lakh?

Solution

Place Value	L	T Th	Th	H	T	O	
1 lakh	1	0	0	0	0	0	$\frac{1\text{lakh}}{1\text{thousand}} = \frac{100000}{1000} = 100$
1 thousand			1	0	0	0	

Lakh is 2 places to the left of thousand. So, it is $10 \times 10 = 100$ times thousand.
Hence, 1 lakh = 100 thousands.

Example 1.4

How many thousands are there in 1 million?

Solution

Place Value	M	H Th	T Th	Th	H	T	O	
1 million	1	0	0	0	0	0	0	$\frac{1\text{ million}}{1\text{ thousand}} = \frac{1000000}{1000} = 1000$
1 thousand				1	0	0	0	

Million is 3 places to the left of Thousand.
1000 Thousands (1000x1000 = 1,000,000) are in a million.

TRY THESE

1. How many hundreds are there in 10 lakh?
2. How many lakhs are there in a million?
3. 10 lakh candidates write the Public Exam this year. If each exam centre is allotted with 1000 candidates. How many exam centres would be needed?

Exercise 1.1

1. Fill in the blanks.
   (i) The smallest 7 digit number is __________.
   (ii) The largest 8 digit number is __________.
   (iii) The place value of 5 in 7005380 is __________.
   (iv) The expanded form of the number 76,70,905 is __________.

2. Say True or False.
   (i) Successor of a one digit number is always a one digit number
   (ii) Predecessor of a 3-digit number is always a 3 or 4-digit number
   (iii) In the Indian System of Numeration the number 67999037 is written as 6,79,99,037.
   (iv) $88,888 = 8 \times 10000 + 8 \times 100 + 8 \times 10 + 8 \times 1$

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3. How many ten thousands are there in the smallest 6 digit number?

4. Observe the commas and write down the place value of 7.

   (i) 56,74,56,345 (ii) 567,456,345

5. Write the following numbers in the International System by using commas.

   (i) 347056 (ii) 7345671 (iii) 634567105 (iv) 1234567890

6. Write the largest six digit number and put commas in the Indian and the International Systems.

7. Write the number names of the following numerals in the Indian System.

   (i) 75,32,105 (ii) 9,75,63,453

8. Write the number names in words using the International System.

   (i) 345,678 (ii) 8,343,710 (iii) 103,456,789

9. Write the number name in numerals.

   (i) Two crore thirty lakh fifty one thousand nine hundred eighty.

   (ii) Sixty six million three hundred forty five thousand twenty seven.

   (iii) Seven hundred eighty nine million two hundred thirteen thousand four hundred fifty six.

10. Tamil Nadu has about twenty six thousand three hundred forty five square kilometre of Forest land. Write the number mentioned in the statement in Indian System and International System.

11. The number of employees in the Indian Railways is about ten lakhs. Write this in the International System of numeration.

Objective Type Questions

12. The successor of 10 million is

    (a) 1000001 (b) 10000001 (c) 9999999 (d) 100001

13. The difference between the successor and the predecessor of 99999 is

    (a) 90000 (b) 1 (c) 2 (d) 99001

14. 1 billion is equal to

    (a) 100 crore (b) 100 million (c) 100 lakh (d) 10000 lakh

15. The expanded form of the number 6,70,905 is

    (a) $6 \times 10000 + 7 \times 1000 + 9 \times 100 + 5 \times 1$

    (b) $6 \times 10000 + 7 \times 1000 + 0 \times 100 + 9 \times 100 + 0 \times 10 + 5 \times 1$

    (c) $6 \times 1000000 + 7 \times 10000 + 0 \times 1000 + 9 \times 100 + 0 \times 10 + 5 \times 1$

    (d) $6 \times 100000 + 7 \times 10000 + 0 \times 1000 + 9 \times 100 + 0 \times 10 + 5 \times 1$

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1.4 Comparison of Numbers

We are familiar with the concept of comparing numbers and finding the biggest among them. We use symbols <, > and = to compare any two numbers.

1.4.1 Comparing numbers with unequal number of digits

1. When we compare the numbers 16090 and 100616, we have already learnt that the number with more digits is greater.

   Hence, 1,00,616 (6 digit number) > 16,090 (5 digit number).

TRY THESE

1. Write the numbers in the ascending order: 688, 9, 23005, 50, 7500.
2. Find the least and the greatest among the numbers: 478, 98, 6348, 3, 6007, 50935.

2. Suppose we are given more than two numbers say 1468, 5, 201, 69 and 70000. Then among these, we can immediately say that the number 70000 is the greatest and 5 is the least, based on the number of digits.

1.4.2 Comparing numbers with equal number of digits

Think about the situation

In a distance analysis chart, the distance between Chennai and New Delhi is 2180 k.m. and Chennai to Noida is 2158 k.m. respectively. Which city is farther from Chennai?

Step 1	Step 2	Step 3	
Compare the thousands place of two numbers 2 1 8 0 2 1 5 8 Here digit at the thousands place of both numbers are the same. We can't arrive at any conclusion. So, we move on to the next step.	Compare the hundreds place of two numbers 2 1 8 0 2 1 5 8 Here digit at the hundreds place of both numbers are the same. We can't arrive at any conclusion. So, we move on to the next step.	Compare the tens place of two numbers 2 1 8 0 2 1 5 8 Here digit at the tens place of both numbers are different, So, the number with the greatest tenth place will be the greater. Therefore, 2180 > 2158	Think! Why we need not compare the one's place?

Compare the given numbers 2180 and 2158 using the above mentioned steps.

2 = 2	1 = 1	8 > 5

Hence, 2180 > 2158. So, New Delhi is farther from chennai.

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Example 1.5

Compare 59283746 and 59283748 using place value chart.

Solution

Step 1: Number of digits in the two given numbers are equal.

Step 2: Compare the place values using the place value chart.

Place Value	C	T L	L	T Th	Th	H	T	O
First Number	5	9	2	8	3	7	4	6
Second Number	5	9	2	8	3	7	4	8

Compare the digits of the two numbers from the highest place value as noted below.

5 = 5	9 = 9	2 = 2	8 = 8	3 = 3	7 = 7	4 = 4	6 < 8

Here only the digits in the ones place are not equal and 6 < 8.

Hence, 59283746 < 59283748.

TRY THESE

Compare the two numbers and put <, > and = using place value chart.

15475		3214
73204		973561
8975430		8975430
1899799		1899799

1.4.3 Arranging the numbers in ascending and descending order

The heights of five different apartments named as A, B, C, D and E in a locality are 985 feet, 1245 feet, 1865 feet, 355 feet and 585 feet respectively. They are shown according to their heights as shown in Fig. 1.1.

Can you arrange them in the ascending order of their heights?

Yes, We can arrange the numbers by comparing them based on the place values.

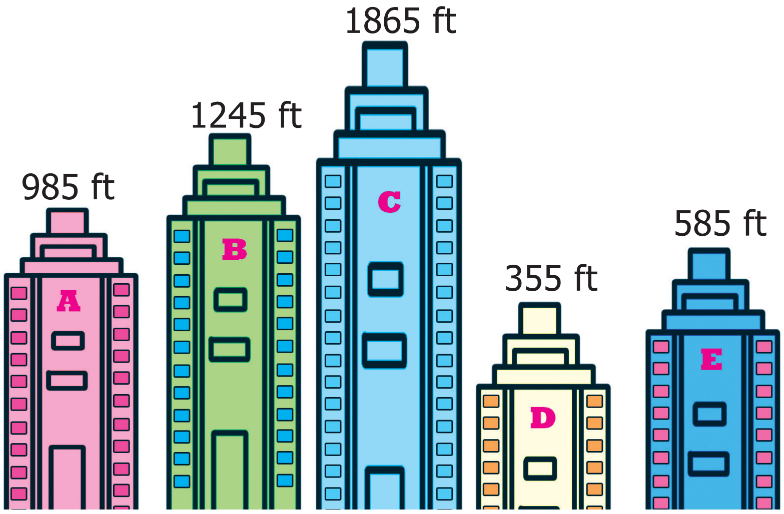

Fig. 1.1

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Step 1

Compare the 4 digit numbers 1245 and 1865. By following the steps mentioned for comparing the numbers having same number of digits, we get 1865 > 1245.

The tallest apartment is 'C' (1865 feet).

The next tallest apartment is 'B' (1245 feet).

Place Value / Apartments	Th	H	T	O
A		9	8	5
B	1	2	4	5
C	1	8	6	5
D		3	5	5
E		5	8	5

Step 2

Compare the three digit numbers 985, 585 and 355. Using the above table, we get, 985 > 585 > 355. The smallest among them is 355.

Hence we write the heights of the apartments in ascending order as,

355 <	585 <	985 <	1245 <	1865
D	E	A	B	C

TRY THESE

The area in sq. k.m. of four Indian states are given below

States	Area (Sq.k.m.)
Tamil Nadu	1,30,058
Kerala	38,863
Karnataka	1,91,791
Andhra Pradesh	1,62,968

List the areas of the above four Indian States in the ascending and the descending order.

DO YOU KNOW?

Thomas Harriot

(1560 - 1621)

A famous mathematician, was the first to use "<" (less than) and ">" (greater than) symbols.

1.5 Creating New Numbers

Using the four digits 9, 4, 8 and 5 we need to make different 4-digit numbers in such a way that the digits are not repeated. We get the following arrangement of different 4-digit numbers.

Th	H	T	O
9	4	8	5
9	4	5	8
9	8	4	5
9	8	5	4
9	5	4	8
9	5	8	4

TRY THESE

In the same way, try placing the digit 4 in thousands place and get six different 4-digit numbers. Also make different 4-digit numbers by fixing 8 and 5 in the thousands place.

ACTIVITY

Divide a chart paper into eight equal parts. Write different 1-digit numbers on it. List out the possible 8 digit numbers and also find the largest and the smallest numbers among them.

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Impact of Place Value

Consider the 4-digit number 3795. When we exchange the digits of two places, the number either becomes larger or smaller. For example, the given number is 3795. If the digits 9 and 5 are exchanged, then the number is 3759. This number is less than the given number. It makes a great impact in the situations like handling currencies.

TRY THESE

- In the same way, make different 4-digit numbers by exchanging the digits and check every time whether the number made is small or big.
- Pedometer used in walking practice contains 5 digit number. What could be the largest measure?

Exercise 1.2

1. Fill in the blanks with > or < or =.

   (i) 48792 _____ 48972

   (ii) 1248654 _____ 1246854

   (iii) 658794 _____ 658794

2. Say True or False.

   (i) The difference between the smallest number of seven digits and the largest number of six digits is 10.

   (ii) The largest 4-digit number formed by the digits 8, 6, 0, 9 using each digit only once is 9086.

   (iii) The total number of 4 digit numbers is 9000.

3. Of the numbers 1386787215, 137698890, 86720560, which one is the largest? Which one is the smallest ?

4. Arrange the following numbers in the descending order:

   128435, 10835, 21354, 6348, 25840

5. Write any eight digit number with 6 in ten lakhs place and 9 in ten thousandth place.

6. Rajan writes a 3-digit number, using the digits 4, 7 and 9. What are the possible numbers he can write?

7. The password to access my ATM card includes the digits 9,4,6 and 8. It is the smallest 4 digit even number. Find the password of my ATM Card.

8. Postal Index Number consists of six digits. The first three digits are 6, 3, and 1. Make the largest and the smallest Postal Index Number by using the digits 0,3 and 6, each only once.

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9. The heights (in metres) of the mountains in Tamil Nadu are as follows:

Sl. No	Mountains	Height (in metres)
1	Doddabetta	2637
2	Mahendragiri	1647
3	Aanaimudi	2695
4	Velliangiri	1778

(i) Which is the highest mountain listed above?

(ii) Order the mountains from the highest to the lowest.

(iii) What is the difference between the heights of the mountains Aanaimudi and Mahendragiri?

Objective Type Questions

10. Which list of numbers is in order from the smallest to the largest?

(a) 1468, 1486, 1484 (b) 2345, 2435, 2235

(c) 134205, 134208, 154203 (d) 383553, 383548, 383642

11. The Arabian Sea has an area of 1491000 square miles. This area lies between which two numbers?

(a) 1489000 and 1492540 (b) 1489000 and 1490540

(c) 1490000 and 1490100 (d) 1480000 and 1490000

12. The chart below shows the number of newspapers sold as per Indian Readership Survey in 2018. Which could be the missing number in the table?

Name of the Newspaper	Ranking	Sold (in Lakh)
A	1	70
B	2	50
C	3	?
D	4	10

(a) 8 (b) 52 (c) 77 (d) 26

1.6 Use of Large Numbers in Daily Life Situations

We know to apply four basic operations on numbers. We will see a few more examples which deal with the four operations such as addition, subtraction, multiplication and division.

Example 1.6

In an exhibition, the number of tickets sold on the first, second, third and fourth days are 1,10,000, 75,060, 25,700 and 30,606 respectively. Find the total number of tickets sold on all the 4 days.

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Solution

Number of tickets sold on the first day	=	1,10,000
Number of tickets sold on the second day	=	75,060
Number of tickets sold on the third day	=	25,700
Number of tickets sold on the fourth day	=	30,606
Adding all the above, the total number of tickets sold on all the 4 days	=	2,41,366

Example 1.7

In a year, a whole-sale paper firm sold 6,25,600 notebooks out of 7,50,000 notebooks. Find the number of notebooks left unsold.

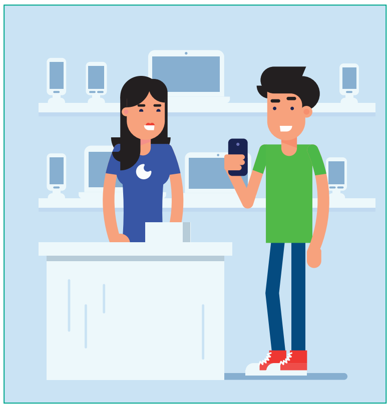
Solution

Number of notebooks in the store	=	7,50,000
Number of notebooks sold	=	6,25,600
Number of notebooks unsold	=	1,24,400

Example 1.8

In a mobile store, the number of mobiles sold during a month is 1250. Assuming that the same number of mobiles are sold every month, find the number of mobiles sold in 2 years.

Solution



Number of mobiles sold in 1 month = 1250

1 year = 12 months

2 years = 2×12

= 24 months

Number of mobiles sold in 24 months = $1250 \times 24 = 30{,}000$

Number of mobiles sold in 2 years = 30,000

Example 1.9

If ₹10,00,000 was distributed in a Government scheme to 500 women in the Self Help Groups, then find the amount given to each woman.

Solution

Amount to be given to 500 women = ₹10,00,000

Amount given to each woman = $10{,}00{,}000 \div 500$ = ₹2000

Each woman in the Self Help Group was given ₹2000.

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1.7 Order of Operations

Think about the situation

Valli and her four friends went to a butter milk shop. Each had a cup of butter milk and paid ₹30, assuming that the cost of one cup of butter milk to be ₹6. But the shop keeper told that the cost of butter milk had increased by ₹2. Then, Valli decided to give ₹2 more and paid ₹32. But the shop keeper claimed that she had to pay ₹40. Who is correct?

Valli calculated as,	Shop keeper calculated as,
$= (5 \times 6) + 2$	$= 5 \times (6 + 2)$
$= 30 + 2$	$= 5 \times 8$
$= 32$	$= 40$

The amount ₹40 claimed by the Shop keeper is correct. This confusion can be avoided by using the brackets in the correct places like $5 \times (6 + 2)$.

The rule of order of operations is called as BIDMAS. In BIDMAS the operations done from left to right.

Expansion of BIDMAS	
B	Bracket ( )
I	Indices (you will learn it later)
D	Division ÷ or /
M	Multiplication ×
A	Addition +
S	Subtraction −

Now, we try to solve $9 + 5 \times 2$ by using BIDMAS,

$$9 + (5 \times 2) = 9 + 10$$
$$= 19$$

Example 1.10

Simplify : $24 + 2 \times 8 \div 2 - 1$

Solution

$24 + 2 \times 8 \div 2 - 1$ (given question)

$= 24 + 2 \times 4 - 1$ (÷ operation, completed first)

$= 24 + 8 - 1$ (× operation, completed second)

$= 32 - 1$ (+ operation, completed third)

$= 31$ (− operation , completed last)

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Example 1.11

Simplify : $20 + [8 \times 2 + \{(6 \times 3) - (10 \div 5)\}]$

Solution

Given,

$20 + [8 \times 2 + \{(6 \times 3) - (10 \div 5)\}]$	
$=20 + [8 \times 2 + \{(6 \times 3) - 2\}]$	(÷ completed first)
$=20 + [8 \times 2 + \{18 - 2\}]$	(× completed second)
$=20 + [8 \times 2 + 16]$	({ } completed third)
$=20 + [16 + 16]$	(× completed fourth)
$=20 + 32$	([ ] operation completed fifth)
$=52$	(+ completed last)

Exercise 1.3

1. Fill in the blanks.
   (i) If Arulmozhi saves ₹ 12 per day, then she saves ₹ _________ in 30 days.
   (ii) If a person 'A' earns ₹ 1800 in 12 days, then he earns ₹ _________ in a day.
   (iii) $45 \div (7 + 8) - 2 =$ _________.
2. Say True or False.
   (i) $3 + 9 \times 8 = 96$ (ii) $7 \times 20 - 4 = 136$ (iii) $40 + (56 - 6) \div 2 = 45$
3. The number of people who visited the Public Library for the past 5 months were 1200, 2000, 2450, 3060 and 3200 respectively. How many people visited the library in the last 5 months.
4. Cheran had a bank savings of ₹ 7,50,250. He withdrew ₹ 5,34,500 for educational purpose. Find the balance amount in his account.
5. In a cycle factory, 1560 bicycles were manufactured every day. Find the number of bicycles manufactured in 25 days.
6. ₹ 62500 was equally distributed as a New Year bonus for 25 employees of a company. How much did each receive?
7. Simplify the following numerical expressions:
   (i) $(10 + 17) \div 3$ (ii) $12 - [3 - \{6 - (5 - 1)\}]$
   (iii) $100 + 8 \div 2 + \{(3 \times 2) - 6 \div 2\}$

Objective Type Questions

8. The value of $3 + 5 - 7 \times 1$ is _________.
   (a) 5 (b) 7 (c) 8 (d) 1

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9. The value of 24 ÷ {8 − (3 x 2)} is __________

(a) 0 (b) 12 (c) 3 (d) 4

10. Use BIDMAS and put the correct operator in the box.

2 ☐ 6 −12 ÷ (4 + 2) = 10

(a) + (b) − (c) × (d) ÷

1.8 Estimation of numbers

Let us see few examples now,

(ix) Nearly 60,000 people watched the Republic day parade at Rajpath, New Delhi.

(x) About 2,80,000 people of various countries died due to earthquake and Tsunami on 26th December 2004 in the Indian ocean.

(xi) The India-Pakistan cricket match was viewed by about 30 million cricket fans in the Television all over the world.

We often come across statements like these in TV channels and dailies. Do these news items, give the exact numbers? No. The numbers mentioned are not accurate. They are only the approximate or closer values to the actual ones. This is the reason, why we generally use words like "about", "nearly" and "approximately". These numbers are only the estimation of the actual value. The word 'about' denotes the number not exactly, but a little more or less. This value is called the estimated value.

The actual figure, though not exactly possible, could have been 59,853 or 61,142 for the first example and it could have been 2,78,955 or 2,80,984 for the second example. Imagine and write about, what could have been the exact number for the third example given above? Similarly, there are many more possible numbers. Thus,

- to get a rough idea we need estimation.
- to get the estimated value, we generally round off the numbers to their nearest tens, hundreds or thousands.

Some real life situations where we use estimates are

(a) Cost of a Television, Refrigerator, Mixer Grinder etc., are usually expressed in thousands of rupees.

(b) The Voters population in an Assembly Constituency in a state is often stated in lakhs.

(c) The Central or State Government's Annual Budget is usually given in lakh crore.

When an exact answer is not necessary, estimation strategies can be used to determine a reasonably close answer.

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ACTIVITY

1. Fill in the jar with some items like Tamarind seeds. Let each student give an estimate of the number of items. Make a table of the result by finding the difference of the estimate and the actual amount.
2. Get a large jar and a bag of Tamarind seeds and put 30 seeds in the jar. Observing the contents, estimate how many seeds roughly will fill the whole jar. Continue to fill the jar to check your estimate.

Rounding off is one way to find a number for estimation that is quite convenient. It gives us the closest suitable number according to a given place value. There are four steps involved in the rounding process. Let us illustrate this with an example.

Example 1.12

Round off the number 8,436 to the nearest hundreds.

Step	To do	8,436 to hundreds
Step 1	Find the digit in hundreds place	8,436
Step 2	Look at the digit to its right	8,436
Step 3	If this digit is 5 or greater, add 1 to it. If it is less than 5, leave it unchanged	8,436 (3 < 5) Leave 4 unchanged
Step 4	Change the digits to the right of 4 to zeros	8,400

Example 1.13

Round off the number 78,794 to the nearest thousands.

Step	To do	78,794 to thousands
Step 1	Find the digit in thousands place	78,794
Step 2	Look at the digit to its right	78,794
Step 3	If this digit is 5 or greater, add 1 to it. If it is less than 5, leave it unchanged	78,794 (7 > 5) Add 1 to 8 and Change 8 to 9
Step 4	Change the digits to the right of 79 to zeros	79,000

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TRY THESE

1. Round off the following numbers to the nearest ten.

   (i) 57 (ii) 189 (iii) 3,956 (iv) 57,312

2. Round off the following numbers to the nearest ten, hundred and thousand.

   (i) 9,34,678 (ii) 73,43,489 (iii) 17,98,45,673

3. The tallest mountain in the world Mount Everest, located in Nepal is 8,848 m high. Its height can be rounded to the nearest thousand as __________.

1.8.1 Estimation of Sum and Difference

Example 1.14

The amount deposited by a Gold merchant in his bank account in the month of January is ₹17,53,740 and in the month of February is ₹15,34,300. Estimate the sum and difference of the amount deposited to the nearest thousand.

Solution

Rounding off to the nearest thousand is as follows.

	Actual Amount	Estimated Amount
Amount deposited in January	₹ 17,53,740	₹ 17,54,000
Amount deposited in February	₹ 15,34,300	₹ 15,34,000
Total amount deposited	₹ 32,88,040	₹ 32,88,000
Difference between the amounts deposited	₹ 2,19,440	₹ 2,20,000

THINK

Is 2,19,440 is rounded off to its nearest thousand as 2,19,000. Why?

1.8.2 Estimation of Product and Quotient

Example 1.15

If the cost of a copy of Thirukkural book is ₹ 188, then find the estimated cost of 31 copies of such books. (Note : Find the rounded values of 188 to hundreds and 31 to tens and then find the result)

DO YOU KNOW?

The number $\mathbf{10^{100}}$ is called **googol** (this is, 10 multiplied 100 times)

The number $\mathbf{10^{googol} = 10^{(10^{100})}}$ is called **googolplex**

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Solution

Here, 188 is nearer to 200 and 31 is nearer to 30.

The exact cost of 31 copies is 188 × 31 = ₹ 5828 whereas,

The estimated cost of 31 copies = 200 × 30 = ₹ 6000

Therefore, the estimated cost of 31 copies of Thirukkural books is ₹ 6000.

Example 1.16

Find the estimated value of 5598 ÷ 689.

Solution

Actual value	Estimated value
$689 \overline{)5598}$ quotient 8	$700 \overline{)5600}$ quotient 8
5512	5600
86	0

Round of the numbers 5598 and 689 to the nearest hundreds are 5600 and 700

Hence, the estimated value of 5598 ÷ 689 is 8

TRY THESE

- Estimate the sum and the difference rounding off to nearest thousands: 8457 and 4573.
- Estimate the product : 39 × 53
- Estimate the quotient : 6845 ÷ 395

Exercise 1.4

1. Fill in the blanks.
   (i) The nearest 100 of 843 is ________________.
   (ii) The nearest 1000 of 756 is ________________.
   (iii) The nearest 10000 of 85654 is ______________.

2. Say True or False.
   (i) 8567 is rounded off as 8600 to the nearest 10.
   (ii) 139 is rounded off as 100 to the nearest 100.
   (iii) 1,70,51,972 is rounded off as 1,70,00,000 to the nearest lakh.

3. Round off the following to the given nearest place.
   (i) 4,065; hundred (ii) 44,555; thousand
   (iii) 86,943; ten thousand (iv) 50,81,739; lakh
   (v) 33,75,98,482; ten crore

4. Estimate the sum of 157826 and 32469 rounded off to the nearest ten thousand.

5. Estimate by rounding off each number to the nearest hundred.
   (i) 8074 + 4178 (ii) 1768977 + 130589

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6. The population of a city was 43,43,645 in the year 2001 and 46,81,087 in the year 2011. Estimate the increase in population by rounding off to the nearest thousand.

Objective Type Questions

7. The number which on rounding off to the nearest thousand gives 11000 is

   (a) 10345 (b) 10855 (c) 11799 (d) 10056

8. The estimation to the nearest hundred of 76812 is

   (a) 77000 (b) 76000 (c) 76800 (d) 76900

9. The number 9785764 is rounded off to the nearest lakh as

   (a) 9800000 (b) 9786000 (c) 9795600 (d) 9795000

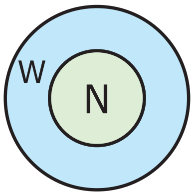
10. The estimated difference of 167826 and 2765 rounded off to the nearest thousand is

   (a) 180000 (b) 165000 (c) 140000 (d) 155000

1.9 Whole Numbers

What is Mathematics about? It is about numbers, perhaps about shapes as well. It is true that people usually count 1,2,3... on various situations. This collection of counting numbers {1,2,3,...} is called Natural numbers, denoted by N. If this collection includes 0 as well, then the collection {0,1,2,3,...} is called Whole numebrs, denoted by W.

1.9.1 Recall the facts on Natural and Whole Numbers



- The smallest natural number is 1.
- The smallest whole number is 0.
- Every number has a successor. The number that comes just after the given number is its successor.
- Every number has a predecessor. The number 1 has a predecessor in W namely '0', but it has no predecessor in N. The number '0' has no predecessor in W.
- There is an order to numbers. By comparing the two given numbers the larger of the two can be identified.
- Numbers are endless. By adding 1 to any chosen large number, the next number can be found.

Logical and Mathematical operations of numbers are used in everyday arithmetic of numbers. These operations can be made easier using properties. Certain properties of numbers are already used without actually knowing them. For example, while adding 8 + 2 + 7, one way of adding is, 8 and 2 are added first to get 10 and then 7 is added to it. The other way of adding this is, 2 and 7 added first to get 9 of then 8 is added to 9 to get 17 which is same as the are about in first way

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TRY THESE

- Find the value of 6 + 3 + 8 and 3 + 6 + 8
  i) Are they same?
  ii) Is there any other way of arranging these three numbers?
- Find the value of 5 × 2 × 6 and 2 × 5 × 6
  i) Are they same?
  ii) Is there any other way of arranging these three numbers?
- Is 7 − 5, the same as 5 − 7? Why?
- What is the value of (15 − 8) − 6? Is it the same as 15 − (8 − 6)? Why?
- What is 15 ÷ 5? Is it the same as 5 ÷ 15? Why?
- What is the value of (100 ÷ 10) ÷ 5? Is it the same as 100 ÷ (10 ÷ 5)? Why?

1.10 Properties of Whole Numbers

The properties of numbers are important facts to be remembered,which helps to do arithmetic calculations more precisely and to avoid mistakes.

1.10.1 Commutativity of addition and multiplication

When two numbers are added (or multiplied), the order of the numbers does not affect the sum (or the product). This is called commutativity of addition (or multiplication).

Observe the given facts:

(i)	43 + 57	=	57 + 43
(ii)	12 × 15	=	15 × 12
(iii)	35,784 + 48,12,69,841	=	48,12,69,841 + 35,784
(iv)	39,458 × 84,321	=	84,321 × 39,458

Such facts are called as equations. In each of the above equations, the answers on both the sides are same. Finding the answer for the third and fourth equations takes more time. But, these equations are meant to convey the properties of numbers. The third equation is correct by commutativity of addition and the fourth equation is correct by commutativity of multiplication.

There is a nice pictorial way of understanding commutativity of multiplication. If we have 5 rows of stars, each with 4 stars, we can draw the total of 20 stars as a rectangle (5 × 4 = 20). See Fig.1.2 below. Now rotate the rectangle given in Fig.1.2 (a) to get the Fig.1.2(c) as given below. It is the same rectangle. It has exactly the same total number of stars, 20. But now we have 4 rows of stars, each with 5 stars! That is, 5 × 4 = 4 × 5.

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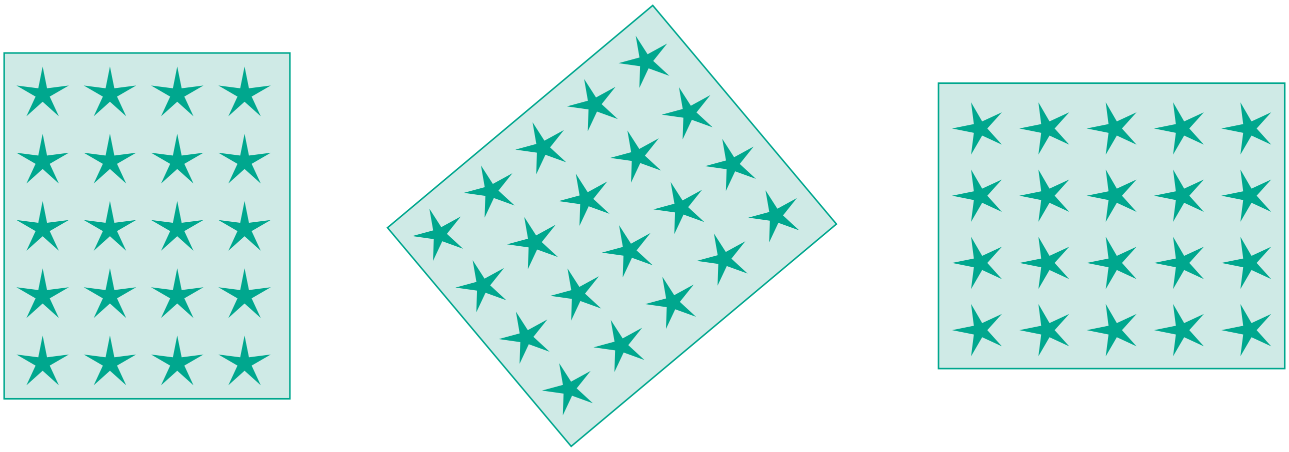

(a) (b) (c)

Fig. 1.2

Now, look at the following example.

7 − 3 = 4 but 3 − 7 will not give the same answer. Similarly, the answers of 12 ÷ 6 and 6 ÷ 12 are not equal.

That is, $7 - 3 \neq 3 - 7$ and $12 \div 6 \neq 6 \div 12$

Hence, In whole numbers subtraction and division are not commutative.

TRY THESE

- Use atleast three different pairs of whole numbers to verify that subtraction is not commutative.
- Is 10 ÷ 5, the same as 5 ÷ 10? Justify it by taking two more combinations of numbers.

1.10.2 Associativity of addition and multiplication

When several numbers are added, the order in which the numbers are added does not matter. This is called associativity of addition. Similarly, when several numbers are to be multiplied, the order in which the numbers are multiplied does not matter. This is called associativity of multiplication.

It can be said that the following equations are correct, without actually doing any addition or multiplication, but by using the property of associativity. A few examples are given below:

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$$(43 + 57) + 25 = 43 + (57 + 25)$$
$$12 \times (15 \times 7) = (12 \times 15) \times 7$$
$$35{,}784 + (48{,}12{,}69{,}841 + 3) = (35{,}784 + 48{,}12{,}69{,}841) + 3$$
$$(39{,}458 \times 84{,}321) \times 17 = 39{,}458 \times (84{,}321 \times 17)$$

It is to be noted that here too, subtraction and division are not associative.

1.10.3 Distributivity of multiplication over addition or subtraction

An interesting fact relating to addition and multiplication comes from the following patterns:

$$(72 \times 13) + (28 \times 13) = (72 + 28) \times 13$$
$$37 \times 102 = (37 \times 100) + (37 \times 2)$$
$$37 \times 98 = (37 \times 100) - (37 \times 2)$$

From the last two cases, we are arriving at the following equations:

$$37 \times (100 + 2) = (37 \times 100) + (37 \times 2)$$
$$37 \times (100 - 2) = (37 \times 100) - (37 \times 2)$$

It can be noted that the product of a number and a sum of numbers can be written as the sum of two products. Similarly, the product of a number and a number got by subtraction can be written as the difference of two products. This property is called the property of distributivity of multiplication over addition or subtraction. It is a very useful property to group numbers in a convenient way. Now let us say $18 \times 6 = (10 + 8) \times 6$ in an easy way as shown in Fig.1.3.

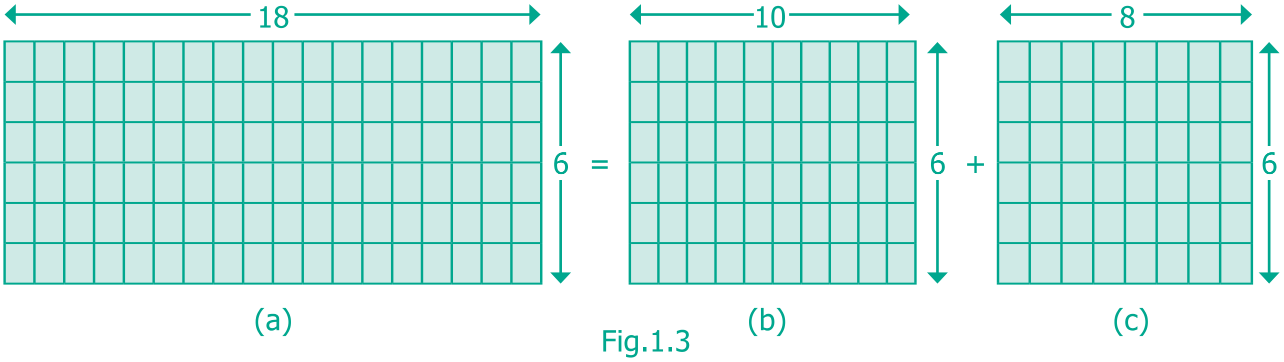

Fig.1.3

Thus, $18 \times 6 = (10 + 8) \times 6$ is shown clearly in the above figure.

It is to be noted that addition does not distribute over multiplication.

For example,

$10 + (10 \times 5) = 60$ and $(10 + 10) \times (10 + 5) = 300$ are not equal.

1.10.4 Identity for addition and multiplication

When zero is added to any number, we get the same number. Similarly, when we multiply any number by 1, we get the same number. So, zero is called the additive identity and one is called the multiplicative identity for whole numbers.

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TRY THESE

Complete the following tables.

9	+	0	=	9
7	+	0	=	
0	+	17	=	17
0	+		=	37
0	+		=	

11	×	1	=	11
1	×	55	=	55
1	×	12	=	
1	×		=	100
1	×		=	

Finally, these are some simple observations that are important.

- When we add any two natural numbers, we get a natural number. Similarly when we multiply any two natural numbers, we get a natural number.
- When we add any two whole numbers, we get a whole number. Similarly when we multiply any two whole numbers, we get a whole number.
- When we add a natural number to a whole number, we get a natural number. When we multiply a natural number by a whole number, we get a whole number.

NOTE

- Any number multiplied by zero gives zero.

TRY THESE

Complete the table.

6	+	8	=	14, a natural number
4	+	5	=	9, a natural number
4	×	5	=	20, a natural number
6	×	8	=	48, a natural number
	+		=	
	+		=	
	×		=	
	×		=	
6	+	8	=	14 , a whole number
4	+	5	=	9, a whole number
15	×	0	=	0, a whole number
11	×	2	=	22, a whole number
	+		=	
	+		=	
	×		=	
	×		=	

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All such properties together play a vital role in the Number System. When we learn Algebra, we can realise the usefulness of these properties of the Number System and we can find ways of extending it too.

DO YOU KNOW?

How will you read the large number given below?
731,687,303,715,884,105,727
This is read as 731 quintillion, 687 quadrillion, 303 trillion, 715 billion, 884 million, 105 thousand, 727 ones.

Exercise 1.5

1. Fill in the blanks.

   (i) The difference between the smallest natural number and the smallest whole number is __________.

   (ii) 17 × __________ = 34 × 17

   (iii) When __________ is added to a number, it remains the same.

   (iv) Division by __________ is not defined.

   (v) Multiplication by __________ leaves a number unchanged.

2. Say True or False.

   (i) 0 is the identity for multiplication of whole numbers.

   (ii) Sum of two whole numbers is always less than their product.

   (iii) Both addition and multiplication are associative for whole numbers.

   (iv) Both addition and multiplication are commutative for whole numbers.

   (v) Multiplication is distributive over addition for whole numbers.

3. Name the property being illustrated in each of the cases given below.

   (i) $75 + 34 = 34 + 75$ (ii) $(12 \times 4) \times 8 = 12 \times (4 \times 8)$

   (iii) $50 + 0 = 50$ (iv) $50 \times 1 = 50$

   (v) $50 \times 42 = 50 \times 40 + 50 \times 2$

4. Use the properties of whole numbers and simplify.

   (i) 50×102 (ii) $500 \times 689 - 500 \times 89$

   (iii) $4 \times 132 \times 25$ (iv) $196 + 34 + 104$

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Objective Type Questions

5. $(53 + 49) \times 0$ is

   (a) 102 (b) 0 (c) 1 (d) $53 + 49 \times 0$

6. $\frac{59}{1}$ is

   (a) 1 (b) 0 (c) $\frac{1}{59}$ (d) 59

7. The product of a non-zero whole number and its successor is always

   (a) an even number (b) an odd number

   (c) zero (d) none of these

8. The whole number that does not have a predecessor is

   (a) 10 (b) 0 (c) 1 (d) none of these

9. Which of the following expressions is not zero?

   (a) 2×0 (b) $0 + 0$ (c) $2 + 0$ (d) $0 - 0$

10. Which of the following is not true?

    (a) $(4237 + 5498) + 3439 = 4237 + (5498 + 3439)$

    (b) $(4237 \times 5498) \times 3439 = 4237 \times (5498 \times 3439)$

    (c) $4237 + 5498 \times 3439 = (4237 + 5498) \times 3439$

    (d) $4237 \times (5498 + 3439) = (4237 \times 5498) + (4237 \times 3439)$

Exercise 1.6

Miscellaneous Practice Problems

1. Try to open my locked suitcase which has the biggest 5 digit odd number as the password comprising the digits 7, 5, 4, 3 and 8. Find the password.
2. As per the census of 2001, the population of four states are given below. Arrange the states in ascending and descending order of their population.

State	Population
Tamil Nadu	72147030
Rajasthan	68548437
Madhya Pradesh	72626809
West Bengal	91276115

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3. Study the following table and answer the questions.

Year	No. of Tigers
1990	3500
2008	1400
2011	1706
2014	2226

(i) How many tigers were there in 2011?

(ii) How many tigers were less in 2008 than in 1990?

(iii) Did the number of tigers increase or decrease between 2011 and 2014? If yes, by how much?

4. Mullaikodi has 25 bags of apples. In each bag there are 9 apples. She shares them equally amongst her 6 friends. How many apples do each get? Are there any apples left over?

5. A poultry has produced 15472 eggs and fits 30 eggs in a tray. How many trays do they need?

Challenging Problems

6. Read the table and answer the following questions.

Name of the Star	Diameter (in miles)
Sun	864730
Sirius	1556500
Canopus	25941900
Alpha Centauri	1037700
Arcturus	19888800
Vega	2594200

(i) Write the Canopus star's diameter in words, in the Indian and the International System.

(ii) Write the sum of the place values of 5 in Sirius star's diameter in the Indian System.

(iii) Eight hundred sixty four million seven hundred thirty. Write in Indian System.

(iv) Write the diameter in words of Arcturus star in the International System.

(v) Write the difference of the diameters of Canopus and Arcturus stars in the Indian and the International Systems.

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7. Anbu asks Arivu Selvi to guess a five digit odd number. He gives the following hints.

   - The digit in the 1000s place is less than 5
   - The digit in the 100s place is greater than 6
   - The digit in the 10s place is 8

   What is Arivu Selvi answer? Does she give more than one answer?

8. A Music concert is taking place in a stadium. A total of 7,689 chairs are to be put in rows of 90. (i) How many rows will there be? (ii) Will there be any chairs left over?

9. Round off the seven digit number 29,75,842 to the nearest lakhs and ten lakhs. Are they the same?

10. Find the 5 or 6 or 7 digit numbers from a newspaper or a magazine to get a rounded number to the nearest ten thousand.

Summary

- Use of commas helps us in reading and writing large numbers.
- Use of commas differs in the Indian and the International Systems.
- Comparing any two numbers, the one with more digits is larger.
- Comparing any two numbers, if the digits are the same, the number that has a greater left most digit is larger.
- Using BIDMAS, we can avoid the common arithmetic mistakes.
- Large numbers are needed for various situations in our daily life.
- The situations where we do not need the exact quantity give rise to estimation or approximation.
- Estimation is approximating a quantity to a reasonable accuracy.
- Rounding of a number involves in getting a quick, desired and rough estimate of it.
- If zero is included in the collection of Natural numbers (N), we get the collection of Whole numbers (W), W = {0, 1, 2, …}.
- ‘0’ is the smallest whole number.
- ‘0’ and ‘1’ are the additive and multiplicative identities of whole numbers respectively.
- Whole numbers can be added or multiplied in any order and hence Commutative.
- Multiplication of Whole numbers is both Commutative and Associative.
- Multiplication is Distributive over addition for Whole numbers.
- Division by ‘0’ is not defined.

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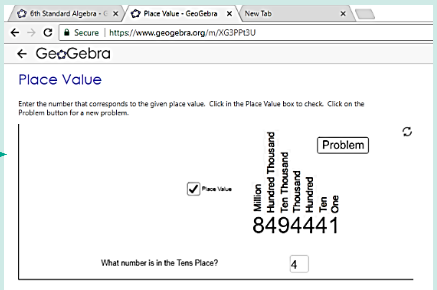
ICT Corner

NUMBERS

Expected Result is shown in this picture



Step – 1

Open the Browser, Copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

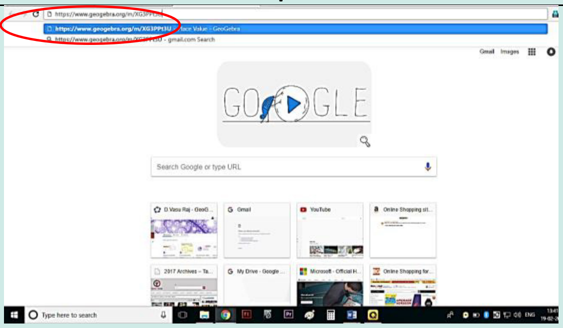
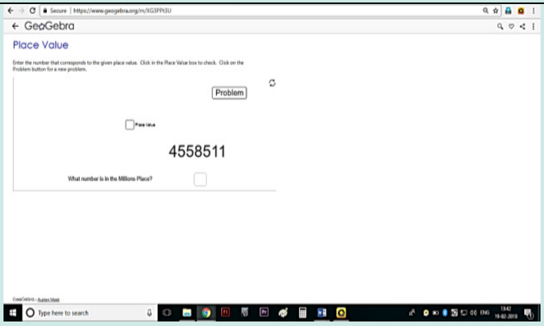
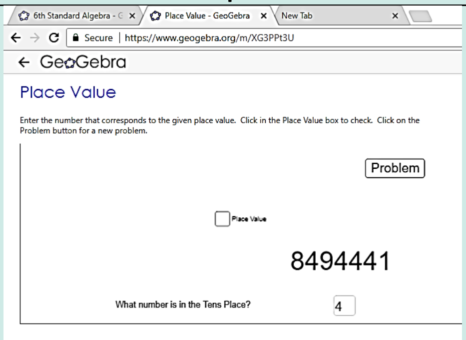
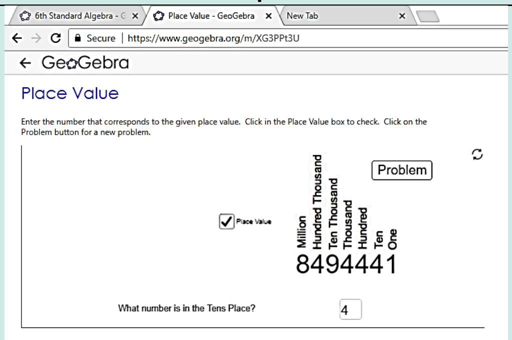
GeoGebra worksheet named "Place Value" will open. A Natural number is given. You can change the problem by clicking on "Problem" button.

Step-3

In the bottom page, Answer the question asked by typing the number related to the question.

Step-4

Now Click on the "Place Value" to see all the place values. Repeat the test by clicking on "Problem".

Step-1	Step-2
	
Step-3	**Step-4**
	

Browse in the link

Place Value: - ***https://www.geogebra.org/m/XG3PPt3U***

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Chapter 2

INTRODUCTION TO ALGEBRA

Learning Objectives

- To describe, extend, create numeric and geometric patterns.
- To make predictions related to the patterns and investigate repeating patterns.
- To understand the role of 'variables' in patterns.
- To use variables in simple algebraic expressions and equations to describe relationships.

2.1 Introduction

Are you ready for a number game? Follow the steps carefully:

Step 1	Step 2	Step 3	Step 4	Step 5
Think of any number	Multiply it by 2	Add 20	Divide by 2	Subtract the original number you had thought in step 1

Is your answer 10? Is it the same for all in the class? Verify it with your friend who might have started with a number other than your number. Surprised? What if you started with a fraction, say $\frac{1}{2}$ or $\frac{3}{4}$ or $\frac{4}{5}$? In this game, regardless of the number you started with, the answer will be 10.

Let us verify the game for two more numbers, say 4 and 9.

- If the initial number is 4,

Step 1	Step 2	Step 3	Step 4	Step 5
4	$4 \times 2 = 8$	$8 + 20 = 28$	$28 \div 2 = 14$	$14 - 4 = 10$

- If the initial number is 9,

Step 1	Step 2	Step 3	Step 4	Step 5
9	$9 \times 2 = 18$	$18 + 20 = 38$	$38 \div 2 = 19$	$19 - 9 = 10$

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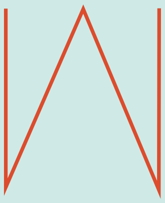
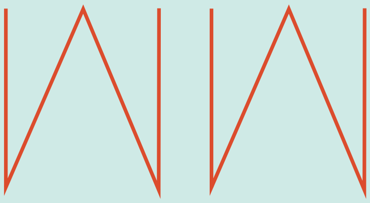
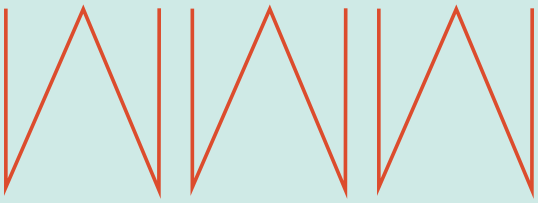
So, we can say that the same will happen for other numbers too.

You will find that Algebra is interesting and useful in solving problems in our daily life such as

- Finding the number of things to its cost.
- Expressing the distance covered, in terms of speed and time.
- Converting miles into kilometres, grams to kilograms etc.
- Finding the length of the barbed wire to fence a garden.
- Finding the area of a park.
- Finding the missing numbers in a sequence.

MATHEMATICS ALIVE – ALGEBRA IN REAL LIFE		
		
4 sticks	8 sticks	12 sticks
1 × 4 sticks	2 × 4 sticks	3 × 4 sticks

2.2 Patterns

Mathematics is easy when we look at it as a study of patterns. Patterns allow us to make reasonable guesses. Understanding patterns provide a clear basis for problem solving skills. In this chapter, we are going to look at patterns that deals with numbers. For example, let us list the numbers we know in order

1, 2, 3, 4, 5, 6, 7, 8, 9, 10...

We observe that 1 is odd, 2 is even, 3 is odd, 4 is even etc. Thus odd numbers and even numbers alternate with each other. If these is a sequence 12, 8, 4 … can you find the next number? Easy, each number is obtained by subtracting 4 from the previous number. So the fourth number is 0.

The branch of Mathematics that deals with such patterns is called Algebra. Today Algebra is used widely in many fields that include banking, insurance, accounting, statistics, science, engineering, manufacturing and so on.

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TRY THESE

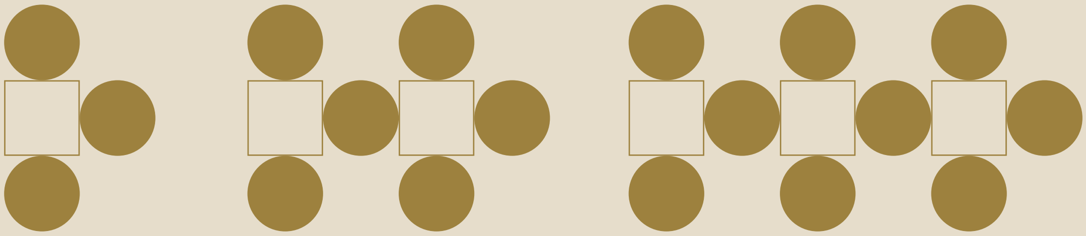
- Observe the following patterns and complete them.

  (i) 5, 8, 11, 14, ___ , ___ , ___

  (ii) If 15873 × 7 = 111111 and 15873 × 14 = 222222 then what is

  15873 × 21 =? and 15873 × 28 =?

- Draw the next two patterns and complete the table.



Pattern	1st	2nd	3rd	4th	5th
Squares	1	2	3		
Circles	3	6	9		

- Create your own pattern of shapes and prepare a table.

2.2.1 Patterns in Number Operations

In the first chapter on Whole Numbers, you have learnt about numbers that are multiplied by 1 or 0.

For example, we know, 57 × 1 = 57 and 43 × 0 = 0.

But we also know that this statement is true for all numbers (not just for the above two). So, can we say "any number" × 1 = "the same number" that we started with?

Algebra gives a way for writing such facts in a short and sweet way. We can write the above statement as $n \times 1 = n$, where n is a number. Here n on the left-hand side is just a letter that is used instead of saying "any number". The number on the right-hand side is the same n. This ensures that we get a correct statement!

In Algebra, we say that "n" is a *variable*. A variable is a symbol (usually an alphabet like n or x) that represents a number. Variables often help us to write briefly what we mean by a relation. In $n \times 1 = n$, left side number quantity 1 do not vary always. So we call it as *constant*.

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For example, the following patterns such as,

$$7 + 9 = 9 + 7$$
$$57 + 43 = 43 + 57$$
$$123 + 456 = 456 + 123$$
$$7098 + 2018 = 2018 + 7098$$
$$35784 + 481269841 = 481269841 + 35784$$

can be simply summarized as $a + b = b + a$.

Here, we have two variables namely "a" and "b". Each variable can take "*any value*", but the value of 'a' is the same on both sides, and the value of 'b' is also the same on both sides. But, the values of 'a' and 'b' need not be equal to each other.

Can you give a similar intrepretation for $a \times b = b \times a$?

NOTE

Similar rules cannot be written for subtraction! We know what is '$7 - 3$', but not '$3 - 7$'. So '$a - b$' and '$b - a$' are not the same!

2.3 Understanding operations on Variables

Consider the following situations.

Situation 1:

Mathi is 3 years elder than his sister Nila. If we know Nila's age, can we find Mathi's?

If Nila's age is 'n', you can see that Mathi's age is always '$n + 3$'. This is the advantage of using variables. We do not need different statements for different values of the age! As we give different values for 'n', we get different values for '$n + 3$', here 3 is a *constant*. This is clear from the following table.

Nila's age 'n'	Mathi's age '$n + 3$'
If $n = 4$	7
If $n = 8$	11
If $n = 12$	15

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Situation 2:

Patterns using Ice Candy Sticks

Pari and Manimegalai made some patterns with ice candy sticks.

To make one 'T', how many ice candy sticks are used by them? (Two sticks)

To make two 'T's, how many ice candy sticks are used by them? (Four sticks)

Continuing this, they prepared the following table to find the number of ice candy sticks used by them

Number of 'T's formed	1	2	3	4	. . .	k	. . .
Number of ice candy sticks used / required	2	4	6	8	. . .	2k	. . .
	1 × 2	2 × 2	3 × 2	4 × 2	. . .	k × 2	. . .

From the above table, it is clear that if the number of 'T's required by them is 'k' then the number of ice candy sticks required by them will be $k \times 2 = 2k$. Here 'k' is a variable.

TRY THESE

Use a variable to write the rule, which gives the number of ice candy sticks required to make the following patterns.

(i) a pattern of letter C as (ii) a pattern of letter M as

2.4 Framing Algebraic Statements

Consider that there are 'n' number of apples in a basket. If 5 more apples are added, what will be the total number of apples in the basket now?

The total number of apples can be easily framed into an algebraic statement as '$n + 5$'. This algebraic statement '$n + 5$' tells that, whatever be the number of apples you had earlier, there are 5 more apples now in the basket.

- Suppose there are unknown number of people in a bus, say 'x' and if 2 more people get into the bus, then there will be '$x + 2$' people in the bus.

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- There is a patty of butter which weighs 'w' grams. If you cut off 100 grams from it, you will have '$w - 100$' grams left.
- If you start with a number 'y' and then double it, you can write it as '$2y$' (you know, '$2y$' means 2 multiplied by y).

2.4.1 Converting Algebraic statements to Verbal statements

A few examples are given in the following table.

Sl. No	Algebraic statement	Verbal statement
1.	$m + 14$	14 more than 'm'
2.	$x - 6$	'x' is reduced by 6
3.	$3y$ (or) $3 \times y$	product of 3 and 'y'
4.	$5 \div z$ (or) $\frac{5}{z}$	5 divided by 'z'
5.	$2p - 5$	5 less to 2 times 'p'

Likewise, verbal statements can be converted to algebraic statements as follows.

TRY THESE

Sl. No	Algebraic statement	Verbal statement
1.	$a + 5$	
2.	$6z - 1$	
3.	$12y$	
4.	$\frac{x}{6}$	

2.4.2 Converting Verbal statements to Algebraic Statements

A few examples are given in the following table.

Sl. No	Verbal statement	Algebraic statement
1.	'x' is increased by 21	$x + 21$
2.	7 is taken away from 'a'	$a - 7$
3.	Twice 'p'	$2p$
4.	10 divided by 'm'	$10 \div m$
5.	The product of 7 and 'y' is divided by 2	$7y \div 2$

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TRY THESE

Sl. No	Verbal statement	Algebraic statement
1.	Seven times of 'n' minus 5	
2.	The sum of 'x' and 4	
3.	3 times 'y' is divided by 8	
4.	11 is multiplied by 'm'	

2.5 Solving unknowns through examples

Let us fill in the empty boxes

(a) ☐ + 3 = 8 (b) 2 + ☐ = 9 (c) 11 − 5 = ☐

The ☐ stands for an unknown number.

To make the equations meaningful, we shall write 5 in the first box, we shall write 7 in the second box and we shall write 6 in the third box.

TRY THESE

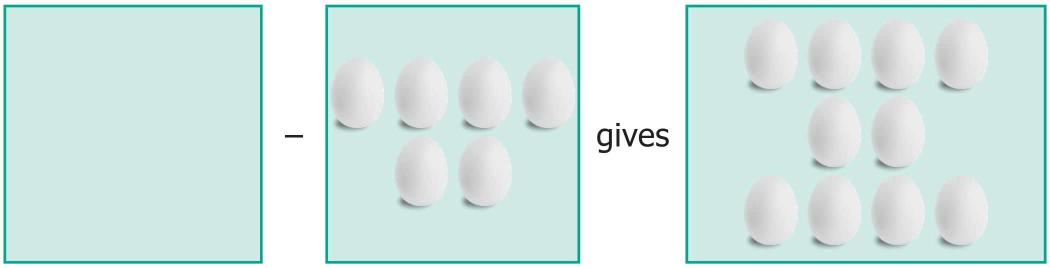
Find the unknown.

(i) 37 + 43 = 43 + ☐ (ii) (22 + 10) + 15 = ☐ + (10 + 15)

(iii) If 7 × 46 = 322 then 46 × 7 = ☐

Example 2.1

Suppose that there are some eggs in a tray. If 6 eggs are taken out from it and still 10 eggs are remaining, how many eggs are there in the tray?



According to the given statement,

Unknown number of eggs in the tray minus 6 eggs gives 10 eggs

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This can be written as, $x - 6$ gives 10, where 'x' denotes the unknown number.

Now, we will find out for what value of 'x', $x - 6$ gives 10.

Value of 'x' Yes/No	$x - 6$	Result	Is it 10?
7	7 – 6	1	No
10	10 – 6	4	No
12	12 – 6	6	No
15	15 – 6	9	No
16	16 – 6	10	Yes
18	18 – 6	12	No

Hence, the unknown number (variable) 'x' takes the value 16.

TRY THIS

Find the suitable value of 'm', to get a sum of 9?

m	$m + 4$	Result	Is it 9? Yes / No
1	1+4	5	No
2	________	________	
3	________	________	
4	________	________	
5	________	________	

Example 2.2

Athiyan and Mugilan are brothers. Athiyan is 'p' years old and Mugilan is elder to Athiyan by 6 years. Write an algebraic statement for this and find the age of Mugilan if Athiyan is 20 years old.

Age of Athiyan = 'p' years

Age of Mugilan = '$p + 6$' years (algebraic statement)

If $p = 20$, then Mugilan's age is = $20 + 6$

= 26 years.

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Exercise 2.1

1. Fill in the blanks.

   (i) The letters $a, b, c, \ldots x, y, z$ are used to represent __________.

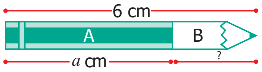
   (ii) The algebraic statement of 'f decreased by 5' is __________.

   (iii) The algebraic statement of 's divided by 5' is __________.

   (iv) If A's age is 'n' years now, 7 years ago A's age was _________.

   (v) If 'p – 5' gives 12 then 'p' is __________.

2. Say True or False.

   (i) 

The length of part B in the pencil shown is 'a – 6'.

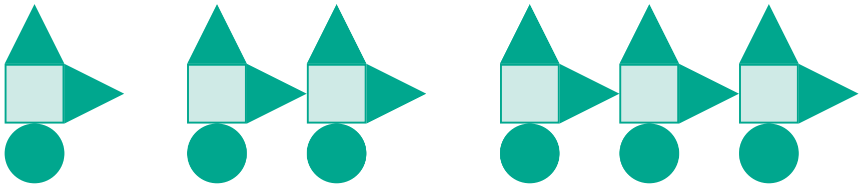
   (ii) If the cost of an is 'x' and the cost of a is ₹5, then the total cost of fruits is ₹ 'x + 5'.

   (iii) 10 more to three times 'c' is '10c + 3'

   (iv) If the cost of 10 rice bags is ₹ 't', then the cost of 1 rice bag is ₹$\frac{'t'}{10}$.

   (v) The product of 'q' and 20 is '20q'.

3. Draw the next two patterns and complete the table.



Shapes	1st Pattern	2nd Pattern	3rd Pattern	4th Pattern	5th Pattern
Squares	1	2	3		
Circles	1	2	3		
Triangles	2	4	6		

4. Arivazhagan is 30 years younger to his father. Write Arivazhagan's age in terms of his father's age.

5. If 'u' is an even number, how would you represent

   (i) the next even number? (ii) the previous even number?

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6. Express the following verbal statement to algebraic statement.

(i) 't' is added to 100. (ii) 4 times 'q'. (iii) 4 less to 9 times of 'y'.

7. Express the following algebraic statement to verbal statement.

(i) $x \div 3$ (ii) $11 + 10x$ (iii) $70s$

8. The teacher asked two students to write the algebraic statement for the verbal statement "8 more than a number". Vetri wrote '$8 + x$' but Maran wrote '$8x$'. Who gave the correct answer?

9. Answer the following questions.

(i) If 'g' is equal to 300 what is the value of '$g - 1$' and '$g + 1$' ?

(ii) What is the value of 's', if '$2s - 6$' gives 30?

10. Complete the table and find the value of 'k' for which $\frac{'k'}{3}$ gives 5.

k	3	6	9	12	15	18
$\frac{k}{3}$	1	2				

Objective Type Questions

11. Variable means that it

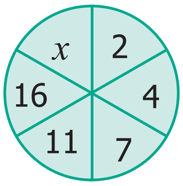
(a) can take only a few values (b) has a fixed value

(c) can take different values (d) can take only 8 values

12. The number of days in 'w' weeks is

(a) $30 + w$ (b) $30w$ (c) $7 + w$ (d) $7w$

13. The value of 'x' in the circle is



(a) 6 (b) 8 (c) 21 (d) 22

14. The value of 'y' in $y + 7 = 13$ is

(a) $y = 5$ (b) $y = 6$ (c) $y = 7$ (d) $y = 8$

15. 6 less to 'n' gives 8 is represented as

(a) $n - 6 = 8$ (b) $6 - n = 8$ (c) $8 - n = 6$ (d) $n - 8 = 6$

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Exercise 2.2

Miscellaneous Practice Problems

1. Complete the following pattern.

   9 − 1 =

   98 − 21 =

   987 − 321 =

   9876 − 4321 =

   98765 − 54321 =

   What comes next?

2. A piece of wire is '12s' cm long. What will be the length of the side, if it is formed as

   (i) an equilateral triangle

   (ii) a square

3. Identify the value of the shapes and figures in the table given below and verify their addition horizontally and vertically.

★	☺	☺	★	= 30
★	★	▲	▲	= 36
★	▲	☺	☺	=
★	☺	▲	☺	=
= 32	=	=	=	=

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4. The table given below shows the results of the matches played by 8 teams in a Kabaddi championship tournament.

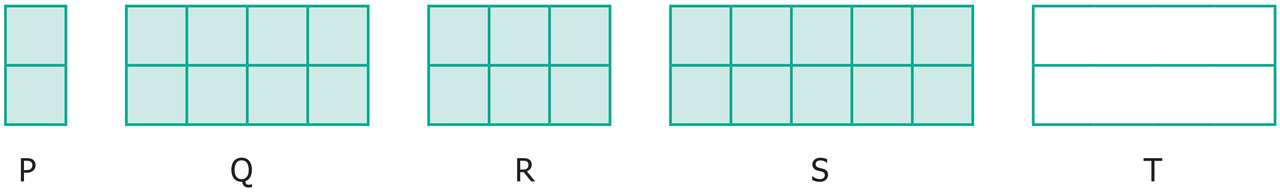
Teams	A	B	C	D	E	F	G	H
Total Matches played	8	7	n	a	9	10	8	y
Matches won	5	6	4	7	b	6	x	3
Matches lost	k	m	6	2	3	c	4	6

Find the value of all the variables in the table given above.

Challenging Problems

5. Gopal is 8 years younger to Karnan. If the sum of their ages is 30, how old is Karnan?

6. The rectangles made of identical square blocks with varying lengths but having only two square blocks as width are given below.



(i) How many small size squares are there in each of the rectangles P, Q, R and S?

(ii) Fill in the boxes.

Rectangle	P	Q	R	S	T
Number of small size squares along the breadth	2	2	?	2	2
Number of squares along the length	1	4	3	?	x
Total number of squares in rectangle	?	8	?	10	?

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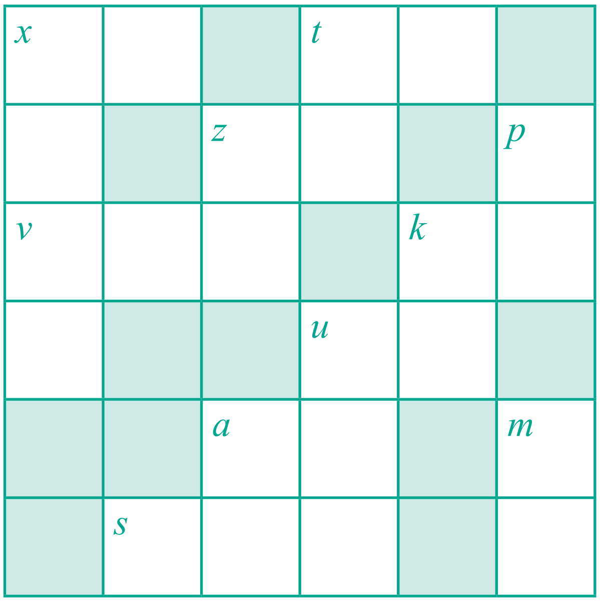
7. Find the variables from the clues given below and solve the cross–word puzzle.



Across	Down
x + 40 gives 100	x is 1005 multiplied by 6
7 reduced from t gives 31	$t \div 7 = 5$
z is 5 added 5 times	p is the predecessor of first 3 digit number
v is the whole number zero plus number of days in a ordinary year	z is the number of weeks in a year (digits reversed)
k is 24 added to 25	k is 11 times 4
u is 2 added to two times 11 gives the number of hours in a day	u is product of 23 and 9
a is 20 more to 40	a is 4 added to the product of 12 and 5
s minus 1 gives 246 is the number of letters in Tamil language	m is the successor of 9

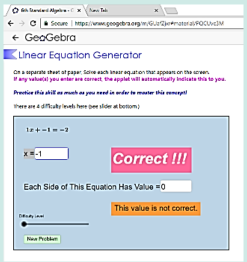
Summary

- Variables are quantities that can take any value and they are denoted by small alphabets $a, b, c, \ldots, x, y, z$.
- Constants are quantities whose value do not change always i.e. a fixed value.
- A Variable allows us to express relations easily in all practical situations.
- Variables are used to generalise and express many common rules of Geometry and Arithmetic.

ICT Corner

INTRODUCTION TO ALGEBRA

Expected Result is shown in this picture



Step – 1

Open the Browser, Copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

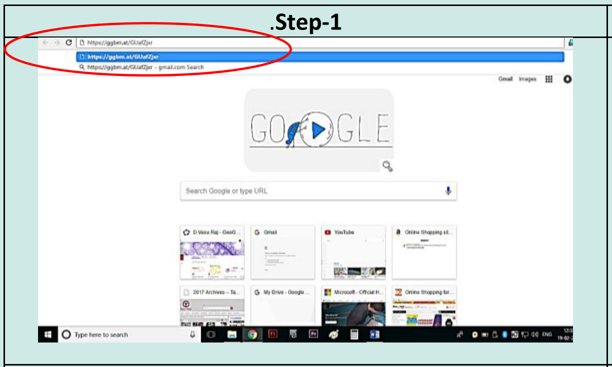
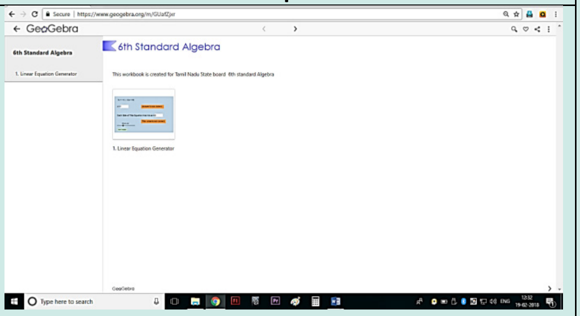
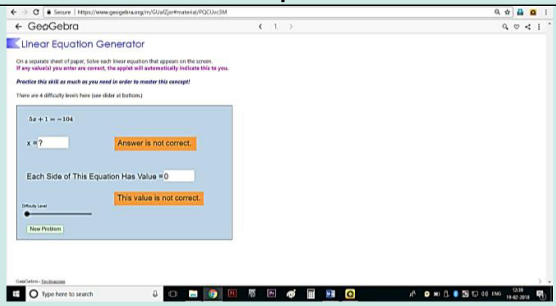
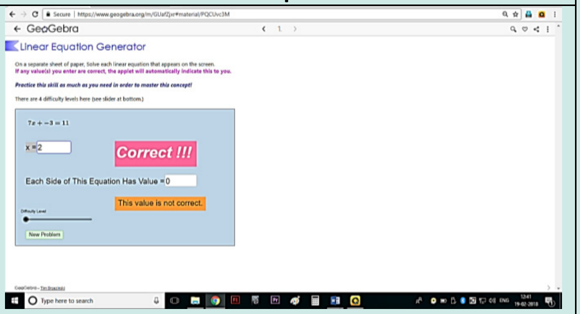
GeoGebra Work Book "**6th Standard Algebra**" will appear. There are several worksheets. In that open "**Linear Equation Generator**"

Step-3

In the page select the difficulty level by moving the slider. Linear equation will appear on the top solve it and enter your answer in the "**x**" box and hit enter.

Step-4

If your answer is correct "**Correct!!!**" menu will appear. Try more problems by clicking on "**New Problem**"

.Step-1	Step-2
	
Step-3	**Step-4**
	

Try the remaining worksheets given in this work book related to your lesson

Browse in the link

Algebra: - https://ggbm.at/GUafZjxr

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Chapter 3

RATIO AND PROPORTION

Learning Objectives

- To understand the concept of ratio.
- To use ratio notation and simplify ratios.
- To divide a quantity into two parts for a given ratio.
- To recognise the relationship between ratio and proportion.
- To use the unitary method and solve simple ratio problems.

Recap

1. Which of the following fractions is not a proper fraction?

   (a) $\frac{1}{3}$ (b) $\frac{2}{3}$ (c) $\frac{5}{10}$ (d) $\frac{10}{5}$

2. The equivalent fraction of $\frac{1}{7}$ is __________.

   (a) $\frac{2}{15}$ (b) $\frac{1}{49}$ (c) $\frac{7}{49}$ (d) $\frac{100}{7}$

3. Write > ,< or = in the box.

   (i) $\frac{5}{8}$ ☐ $\frac{1}{10}$ (ii) $\frac{9}{12}$ ☐ $\frac{3}{4}$

4. Anban says that $\frac{2}{6}$th of the group of triangles given below are blue. Is he correct?

5. Joseph has a flower garden. Draw a picture which shows that $\frac{2}{10}$ th of the flowers are red and the rest of them are yellow.

6. Malarkodi has 10 oranges. If she ate 4 oranges, what fraction of oranges was not eaten by her?

7. After sowing seeds on day one, Muthu observes the growth of two plants and records it. In 10 days, if the first plant grew $\frac{1}{4}$ th of an inch and the second plant grew $\frac{3}{8}$ th of an inch, then which plant grew more?

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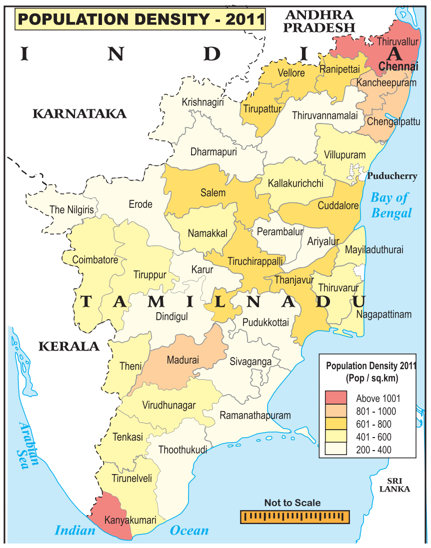
3.1 Introduction

In our daily life, we handle lots of situations where we compare quantities. Comparison of our heights, weights, marks secured in examinations, speeds of vehicles, distances travelled, auto fare to taxi fare, bank balances at different periods of time and many more things are done. Comparison is usually between quantities of the same kind and not of different kind. It will not be meaningful to compare the height of a person with the age of another person. Also, we need a standard measure for comparison.

This sort of comparison by expressing one quantity as the number of times the other is called a '*Ratio*'.

MATHEMATICS ALIVE – RATIO IN REAL LIFE



555 persons to one square k.m.

Male		Female	
Height	Ideal Weight	Height	Ideal Weight
4' 6"	28 - 35 Kg.	4' 6"	28 - 35 Kg.
4' 7"	30 - 39 Kg.	4' 7"	30 - 37 Kg.
4' 8"	33 - 40 Kg.	4' 8"	32 - 40 Kg.
4' 9"	35 - 44 Kg.	4' 9"	35 - 42 Kg.
4' 10"	38 - 46 Kg.	4' 10"	36 - 45 Kg.
4' 11"	40 - 50 Kg.	4' 11"	39 - 47 Kg.
5' 0"	43 - 53 Kg.	5' 0"	40 - 50 Kg.
5' 1"	45 - 55 Kg.	5' 1"	43 - 52 Kg.
5' 2"	48 - 59 Kg.	5' 2"	45 - 55 Kg.
5' 3"	50 - 61 Kg.	5' 3"	47 - 57 Kg.
5' 4"	53 - 65 Kg.	5' 4"	49 - 60 Kg.
5' 5"	55 - 68 Kg.	5' 5"	51 - 62 Kg.
5' 6"	58 - 70 Kg.	5' 6"	53 - 65 Kg.
5' 7"	60 - 74 Kg.	5' 7"	55 - 67 Kg.
5' 8"	63 - 76 Kg.	5' 8"	57 - 70 Kg.
5' 9"	65 - 80 Kg.	5' 9"	59 - 72 Kg.
5' 10"	67 - 83 Kg.	5' 10"	61 - 75 Kg.
5' 11"	70 - 85 Kg.	5' 11"	63 - 77 Kg.
6' 0"	72 - 89 Kg.	6' 0"	65 - 80 Kg.

Comparison of Height and Weight by using ratio

3.2 Ratio

Think about this Situation

Let us consider a situation of cooking rice for two persons. The quantity of rice required for two persons is one cup. To cook every one cup of rice, we need to add two cups of water. Assuming that 8 more guests join for lunch, will the use of ratio help us in handing this situation?

The number of cups of rice and water required are given below.

DO YOU KNOW?

It is possible to trace the origin of the word "ratio" to the Ancient Greek Medieval. Writers used the word proprotio ("proportion") to indicate ratio and proportionalities ("proprotionality") for the equality of ratios. Early translators rendered this into Latin as ratio ("reason"; as in the word "rational")

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Number of cups of rice	1	2	3	4	5
Number of cups of water (or) No. of persons	2	4	6	8	10

In all the cases, the number of cups of water (or) the number of persons is 2 times the number of cups of rice. So, we write

Number of cups of rice : Number of cups of water (or) the number of persons = 1 : 2

Such comparison is called as a Ratio.

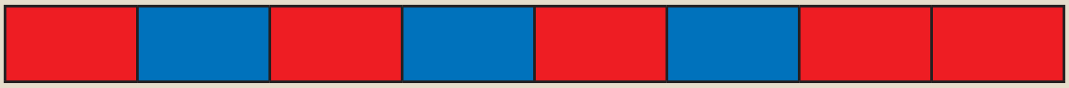
NOTE

- A ratio is a comparison of two quantities with same units.
- If 'a' and 'b' are two different quantities with same unit then, we can write the ratio as a:b (read as a is to b).
- A ratio can be written as a fraction; ratios are mostly written in the simplest form.
- In the above example, the ratio of rice to water in terms of the number of cups can be written in three different ways as 1 : 2 or $\frac{1}{2}$ or 1 to 2 .

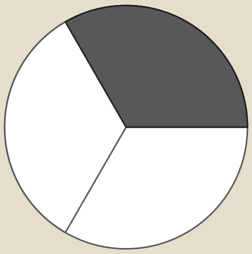
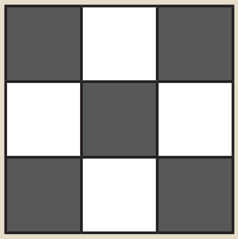
TRY THESE

1. Write the ratio of red tiles to blue tiles and yellow tiles to red tiles.

2. Write the ratio of blue tiles to that of red tiles and red tiles to that of total tiles.



3. Write the ratio of shaded portion to the unshaded portions in the following shapes.

	
Ratio:___________	Ratio:___________

3.2.1 Properties of Ratio

- A ratio has no unit. It is a number. For example, the ratio of 8 km to 4 km is written as 8 : 4 = 2 : 1 and not 2 km : 1 km
- The two quantities in a ratio should be of the *same* unit. The ratio of 4 km to 400 m is expressed as (4 × 1000) : 400 = 4000 : 400 = 10 : 1

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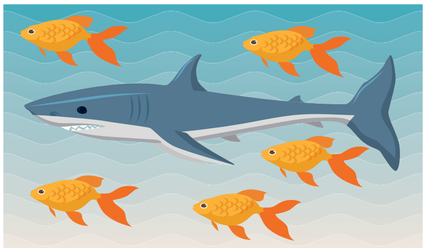
- Each number of the ratio is called *a term*.
- Order of the terms in a ratio cannot be reversed.

A few examples are given below.

 (a)	(b)
Ratio of the number of small fish to the number of big fish is 5 : 1	Ratio of the number of boys to girls in above figure is 5 : 4

In the above example, the ratio of the number of small fish to the number of big fish is 5 : 1. The same information cannot be written as 1 : 5 and so, 5 : 1 and 1 : 5 are not the same.

If in a class, there are 12 boys and 12 girls, then the ratio of number of boys to the number of girls is expressed as 12 : 12 which is the same as 1 : 1.

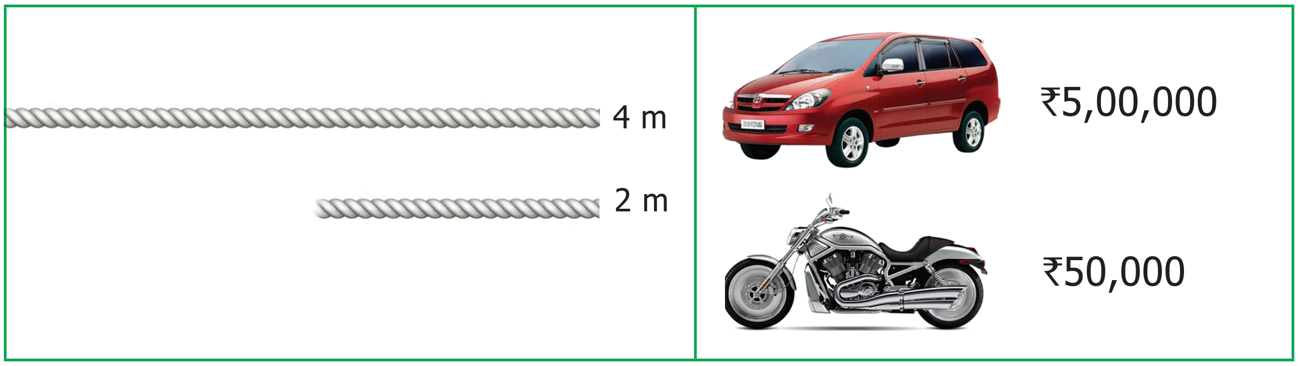
TRY THESE

If the given quantity is in the same unit, put ✓ otherwise put X in the table below.

Sl.No	Quantity	Put ✓ or X
1	5 cm and 100 cm	
2	₹ 5 and 50 oranges	
3	2 m and 75 ml	
4	7 km and 700 m	
5	3 kg of potatoes and 2 kg onions	
6	10 cm and 32 pencils	

3.2.2 Ratios in simplest form

Think about these situations



(a) Fig. 3.1 (b)

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1. The larger rope is 4 m long and the smaller rope is 2 m long. This is expressed in the form of ratio as 4 : 2 and the simplest form of ratio of the larger rope to the smaller rope is 2 : 1 (See Fig. 3.1 (a))
2. The cost of a car is ₹ 5,00,000 and the cost of a motorbike is ₹ 50,000. This is expressed as 500000 : 50000 = 50 : 5 and the simplest form of ratio of the car to the motorbike is 10 : 1 (See Fig. 3.1 (b))

3.2.3 Simplifying ratios of same unit

5 x 1 = 5
5 x 2 = 10
5 x 3 = 15
5 x 4 = 20

Example 3.1

Simplify the ratio 20 : 5.

Solution

Step 1 : Write the ratio in fraction form as $\frac{20}{5}$.

Step 2 : Divide numerator and denominator by 5. That is, $\frac{20 \div 5}{5 \div 5} = \frac{4}{1} = 4 : 1$

This is the ratio in the simplest form.

Example 3.2

Find the ratio of 500 g to 250 g.

Solution

500 g to 250 g = 500 : 250 $\Rightarrow \frac{500}{250} = \frac{500 \div 250}{250 \div 250} = \frac{2}{1} = 2 : 1$

This is the ratio in the simplest form.

Example 3.3

Madhavi and Anbu bought two tables for ₹ 750 and ₹ 900 respectively. What is the ratio of the prices of tables bought by Anbu and Madhavi?

Solution

The ratio of the price of tables bought by Anbu and Madhavi

$= 900:750 = \frac{900}{750} \Rightarrow \frac{900 \div 150}{750 \div 150} = \frac{6}{5} = 6:5$. This is the ratio in the simplest form.

3.2.4 Simplifying ratios of different units

1 hour = 60 minutes
20 x 1 = 20
20 x 2 = 40
20 x 3 = 60

Example 3.4

What is the ratio of 40 minutes to 1 hour?

Solution

Step 1 : Express the quantity in the same unit. (Hint : 1 Hour = 60 minutes)

Step 2 : Now, the ratio of 40 minutes to 60 minutes is $40:60 \Rightarrow \frac{40}{60} = \frac{40 \div 20}{60 \div 20} = \frac{2}{3} = 2:3$

This is the ratio in the simplest form.

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TRY THESE

Write the ratios in the simplest form and fill in the table.

Sl. No.	Quantity	Ratio Form	Fraction Form	Dividing by a common number	Simplest form of Ratio
1	Ratio of 15 girls to 10 boys	15 : 10	$\frac{15}{10}$	$\frac{15 \div 5}{10 \div 5} = \frac{3}{2}$	3 : 2
2	Ratio of 1m 25 cm to 2 m	125 : 200 (1m = 100cm)	$\frac{125}{200}$		
3	Ratio of 3 Kg to 750 g	3000 : 750 (1Kg = 1000g)			
4	Ratio of 70 minutes to 30 minutes				

Exercise 3.1

1. Fill in the blanks.
   (i) Ratio of ₹3 to ₹5 = __________.
   (ii) Ratio of 3 m to 200 c.m = __________.
   (iii) Ratio of 5 k.m 400 m to 6 k.m = __________.
   (iv) Ratio of 75 paise to ₹2 = __________.
2. Say whether the following statements are True or False.
   (i) The ratio of 130 c.m to 1 m is 13 : 10.
   (ii) One of the terms in a ratio cannot be 1.
3. Find the simplified form of the following ratios.
   (i) 15 : 20 (ii) 32 : 24 (iii) 7 : 15 (iv) 12 : 27 (v) 75 : 100
4. Akilan walks 10 k.m in an hour while Selvi walks 6 km in an hour. Find the simplest ratio of the distance covered by Akilan to that of Selvi.
5. The cost of parking a bicycle is ₹5 and the cost of parking a scooter is ₹15. Find the simplest ratio of the parking cost of a bicycle to that of a scooter.
6. Out of 50 students in a class, 30 are boys. Find the ratio of
   (i) number of boys to the number of girls.
   (ii) number of girls to the total number of students.
   (iii) number of boys to the total number of students.

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Objective Type Questions

7. The ratio of ₹1 to 20 paise is __________.

(a) 1 : 5 (b) 1 : 2 (c) 2 : 1 (d) 5 : 1

8. The ratio of 1 l to 50 ml is __________.

(a) 1 : 5 (b) 1 : 20 (c) 20 : 1 (d) 5 : 1

9. The length and breadth of a window are in 1m and 70 cm respectively. The ratio of the length to the breadth is ____________.

(a) 1 : 7 (b) 7 : 1 (c) 7 : 10 (d) 10 : 7

10. The ratio of the number of sides of a triangle to the number of sides of a rectangle is

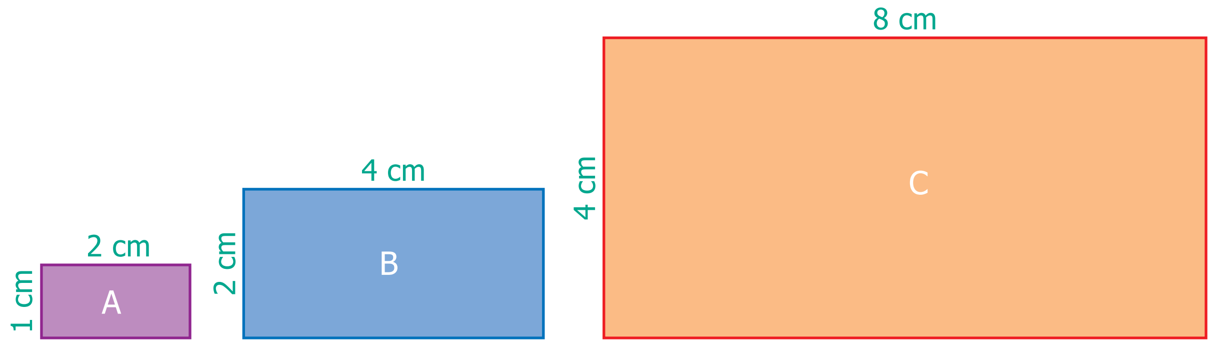
(a) 4 : 3 (b) 3 : 4 (c) 3 : 5 (d) 3 : 2

11. If Azhagan is 50 years old and his son is 10 years old then the simplest ratio between the age of Azhagan to his son is

(a) 10 : 50 (b) 50 : 10 (c) 5 : 1 (d) 1 : 5

3.2.5 Equivalent Ratios

We can get equivalent ratios by multiplying or dividing the numerator and denominator by a common number. This is clear from the following example. Let us find the ratio between breadth and length of the following rectangles given below.



- Ratio of breadth to length of **rectangle A** is **1 : 2** (already in simplest form)
- Ratio of breadth to length of **rectangle B** is **2 : 4** (simplest form is 1 : 2)
- Ratio of breadth to length of **rectangle C** is **4 : 8** (simplest form is 1 : 2)
- Thus, the ratios of breadth and length of rectangles **A**, **B** and **C** are said to be *equivalent ratios*.
- That is, the ratios **1 : 2** = **2 : 4** = **4 : 8** are *equivalent*.

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TRY THESE

1. For the given ratios, find two equivalent ratios and complete the table.

	Ratio	Fraction Form	Equivalent ratio
(i)	1 : 3	$\frac{1}{3}$	$\frac{1}{3} \times \frac{2}{2} = \frac{2}{6} = 2:6$ and $\frac{1}{3} \times \frac{3}{3} = \frac{3}{9} = 3:9$
(ii)	3 : 7	$\frac{3}{7}$	
(iii)	5 : 8	$\frac{5}{8}$	

2. Write three equivalent ratios and fill in the boxes.

	Ratio	Equivalent Ratios		
(i)	4 : 5	8 : ☐	☐ : 50	12 : ☐
(ii)	7 : 2	☐ : 10	14 : ☐	49 : ☐
(iii)	8 : 5	32 : ☐	☐ : 50	16 : ☐

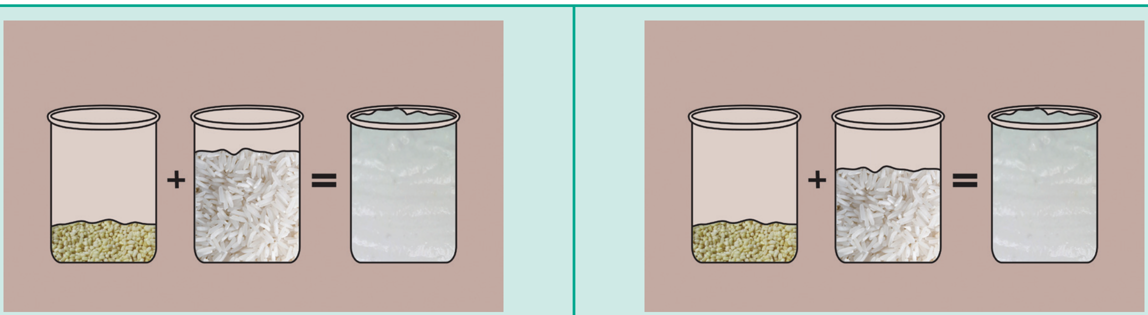
3. For the given ratios, find their simplest form and complete the table.

	Ratio	Fraction Form	Simplest form
(i)	5 : 60	$\frac{5}{60}$	$\frac{5 \div 5}{60 \div 5} = \frac{1}{12} = 1:12$
(ii)	4000 : 6000	$\frac{4000}{6000}$	
(iii)	1100 : 5500		

3.2.6 Comparison of Ratios

Consider the following situations.

Situation 1



In the Idly Batter, the ratio of black gram to idly rice is 1 : 4	In the Idly Batter, the ratio of black gram to idly rice is 1 : 3

(a) Fig. 3.2 (b)

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Can you find which ratio is greater in Fig. 3.2?

Express ratios as a fraction and then find the equivalent fractions, until the denominators are the same, and compare the fractions with common denominators. This is done as follows :

Idly Batter Ratio - (a)	Idly Batter Ratio - (b)
$\frac{1}{4} \times \frac{2}{2} = \frac{2}{8}$	$\frac{1}{3} \times \frac{2}{2} = \frac{2}{6}$
$\frac{1}{4} \times \frac{3}{3} = \frac{3}{12}$	$\frac{1}{3} \times \frac{3}{3} = \frac{3}{9}$
$\frac{1}{4} \times \frac{4}{4} = \frac{4}{16}$	$\frac{1}{3} \times \frac{4}{4} = \frac{4}{12}$

Comparing the equivalent ratios, $\frac{4}{12}$ & $\frac{3}{12}$, we can conclude that 1 : 3 is greater than 1 : 4

Situation 2

Let us consider another situation. For example, if a thread of 5 m is cut at 3 m, then the length of two pieces are 3 m and 2 m and the ratio of the two pieces is 3 : 2. From this we say that, a ratio '$a : b$' is said to have a total of '$a+b$' parts in it.

Example 3.5

Kumaran has ₹600 and wants to divide it between Vimala and Yazhini in the ratio 2 : 3. Who will get more and how much?

Solution

Divide the whole money into 2 + 3 = 5 equal parts then, Vimala gets 2 parts out of 5 parts and Yazhini gets 3 parts out of 5 parts.

Amount Vimala gets = ₹ 600 × $\frac{2}{5}$ = ₹ 240

Amount Yazhini gets = ₹ 600 × $\frac{3}{5}$ = ₹ 360

Vimala received ₹ 240 and Yazhini gets ₹ 360,
which is ₹ 120 more than that of Vimala.

W39CV

Exercise 3.2

1. Fill in the blanks for the given equivalent ratios.

(i) 3 : 5 = 9 : ___ (ii) 4 : 5 = ___ : 10 (iii) 6 : ___ = 1 : 2

2. Complete the table.

(i)

Feet	1	2	3	?
Inch	12	24	?	72

(ii)

Days	28	21	?	63
Weeks	4	3	2	?

3. Say True or False.

(i) 5 : 7 is equivalent to 21 : 15

(ii) If 40 is divided in the ratio 3 : 2, then the larger part is 24.

4. Give two equivalent ratios for each of the following.

(i) 3 : 2 (ii) 1 : 6 (iii) 5 : 4

5. Which of the two ratios is larger?

(i) 4 : 5 or 8 : 15 (ii) 3 : 4 or 7 : 8 (iii) 1 : 2 or 2 : 1

6. Divide the numbers given below in the required ratio.

(i) 20 in the ratio 3 : 2 (ii) 27 in the ratio 4 : 5 (iii) 40 in the ratio 6 : 14

7. In a family, the amount spent in a month for buying Provisions and Vegetables are in the ratio 3 : 2. If the allotted amount is ₹4000, then what will be the amount spent for (i) Provisions and (ii) Vegetables?

8. A line segment 63 cm long is to be divided into two parts in the ratio 3 : 4. Find the length of each part.

Objective Type Questions

9. If 2 : 3 and 4 : ___ are equivalent ratios, then the missing term is

(a) 6 (b) 2 (c) 4 (d) 3

10. An equivalent ratio of 4 : 7 is

(a) 1 : 3 (b) 8 : 15 (c) 14 : 8 (d) 12 : 21

11. Which is not an equivalent ratio of $\frac{16}{24}$?

(a) $\frac{6}{9}$ (b) $\frac{12}{18}$ (c) $\frac{10}{15}$ (d) $\frac{20}{28}$

12. If ₹1600 is divided among A and B in the ratio 3 : 5 then, B's share is

(a) ₹ 480 (b) ₹ 800 (c) ₹ 1000 (d) ₹ 200

3.3 Proportion

When two ratios are equal $\left(\frac{a}{b} = \frac{c}{d}\right)$, we say that the ratios are in Proportion.This is denoted as $a : b :: c : d$ and it is read as 'a is to b as c is to d'. The following situations explain about proportion.

Situation 1

The Teacher said to the students, "You can do a maximum of 4 projects in Mathematics. You will get 5 as internal marks for each project that you do". Kamala asked, "Teacher, What if I do 2 or 3 or 4 projects?" The teacher replied, "For 2 projects you will get 10 marks, for 3 projects you will get 15 marks and for 4 projects you will get 20 marks".

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Here "1 project carries 5 marks" is equivalent to saying "2 projects carry 10 marks" and so on and hence the ratios, 1 : 5 = 2 : 10 = 3 : 15 = 4 : 20 are said to be in Proportion. Thus 1 : 5 is in proportion to 2 : 10, 3 : 15, 4 : 20 and so on. This is denoted by 1 : 5 : : 2 : 10 and it is read as '1 is to 5 as 2 is to 10' and so on.

Situation 2

Fig. 3.3(a)

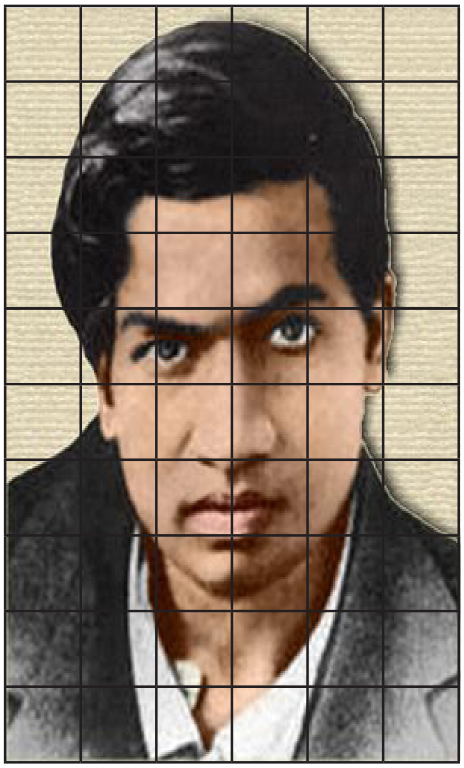

Fig. 3.3(b)

The size of the photograph of Srinivasa Ramanujan as shown in Figure 3.3 (a) is of length 5 grids and breadth 3 grids. Figure 3.3 (b) shows the enlarged size of the photograph of length 10 grids and breadth 6 grids. Here,

Photo grid length	:	Enlarged Photo grid length	=	5 : 10 (1 : 2)	and	Photo grid breadth	:	Enlarged Photo grid breadth	=	3 : 6 (1 : 2)

As the two ratios are equal, the given figures are in proportion. This is represented as 5 : 10 : : 3 : 6 or 5 : 10 = 3 : 6 and it is read as '5 is to 10 as 3 is to 6'

3.3.1 Proportionality law

If two ratios are in proportion ie., $a : b :: c : d$ then the product of the extremes is equal to the product of the means ad=bc. This is called the proportionality law. Here, a and d are the extremes and b and c are the means. Also, if two ratios are equal ie., $\frac{a}{b} = \frac{c}{d} \Rightarrow ad = bc$ is called the cross product of proportions.

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Example 3.6

By proportionality law, check whether 3 : 2 and 30 : 20 are in proportion.

Solution

Here the extremes are 3 and 20 and the means are 2 and 30.

Product of extremes, $ad = 3 \times 20 = 60$.

Product of means, $bc = 2 \times 30 = 60$.

Thus by proportionality law, we find $ad = bc$ and hence 3 : 2 and 30 : 20 are in proportion.

Example 3.7

A picture is resized in a computer as shown below.

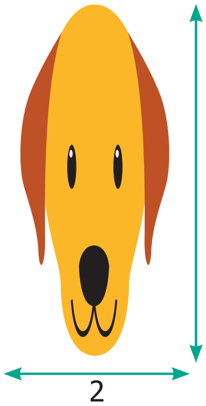

Fig. 3.6 (a)

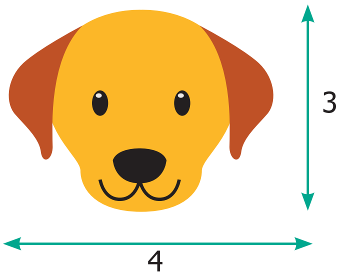

Fig. 3.6 (b)

TRY THIS

1. Fill in the box by using cross product rule of two ratios $\frac{1}{8} = \frac{5}{\square}$
2. Use the digits 1 to 9 only once and write as many ratios that are in proportion as possible. (For example : $\frac{2}{4} = \frac{3}{6}$)

Do you observe any change in shape and size of the picture? Check whether the ratios formed by its length and breadth are in proportion by cross product method.

Solution

The given pictures are in the ratio 2 : 5 and 4 : 3 respectively.

Here the extremes are 2 and 3 and the means are 5 and 4.

Product of extremes, $ad = 2 \times 3 = 6$.

Product of means, $bc = 5 \times 4 = 20$.

Thus, we find $ad \neq bc$ and hence 2 : 5 and 4 : 3 are not in proportion.

3.4 Unitary Method

Finding the value of one unit and then using it to find the value of the required number of units is known as unitary method.

Steps involved in Unitary Method

- Express the given problem in Mathematical statement.
- Find the value of one unit of the given item using division.
- Find the value of the required number of the same items using multiplication.

Example 3.8

Pari wants to buy 5 tennis balls from a sports shop. If a dozen balls cost ₹180, how much should Pari pay to buy 5 balls?

Solution

By unitary method, we can solve this as follows :

Cost of a dozen balls = ₹180

Cost of 12 balls = ₹180

Cost of 1 ball = $\frac{180}{12}$ = ₹15

Cost of 5 balls = 5 x 15 = ₹75

Hence, Pari has to pay ₹75 for 5 balls.

Example 3.9

A heater uses 3 units of electricity in 40 minutes. How many units does it consume in 2 hours?

Solution

In 40 minutes, electricity used = 3 units.

In 1 minute, electricity used = $\frac{3}{40}$ units.

In 120 minutes (2 hours), electricity used = $\frac{3}{40} \times 120$ = 9 units

Thus, the heater consumed 9 units of electricity in 2 hours.

N4IH5

Exercise 3.3

1. Fill in the boxes.

   (i) 3 : 5 : : ☐ : 20 (ii) ☐ : 24 : : 3 : 8

   (iii) 5 : ☐ : : 10 : 8 : : 15 : ☐ (iv) 12 : ☐ = ☐ : 4 = 8 : 16

2. Say True or False.

   (i) 7 Persons is to 49 Persons as 11 k.g is to 88 k.g

   (ii) 10 books is to 15 books as 3 books is to 15 books

   (iiii) If the weight of 40 books is 8 k.g, then the weight of 15 books is 3 k.g.

   (iv) A car travels 90 k.m in 3 hours with constant speed. It will travel 140 k.m in 5 hours at the same speed.

3. Fill in the blanks.

   (i) If the cost of 3 pens is ₹18, then the cost of 5 pens is __________ .

   (ii) If Karkuzhali earns ₹1800 in 15 days, then she earns ₹3000 in __________ days.

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4. Find whether 12, 24, 18, 36 are in order that can be expressed as two ratios that are in proportion.

5. Write the mean and extreme terms in the following ratios and check whether they are in proportion.

   (i) 78 litre is to 130 litre and 12 bottles is to 20 bottles

   (ii) 400 gm is to 50 gm and 25 rupees is to 625 rupees

6. The America's famous Golden Gate bridge is 6480 ft long with 756 ft tall towers. A model of this bridge exhibited in a fair is 60 ft long with 7 ft tall towers. Is the model, in proportion to the original bridge?

7. If a person reads 20 pages of a book in 2 hours, how many pages will he read in 8 hours at the same speed?

8. Cholan walks 6 km in 1 hour at constant speed. Find the distance covered by him in 20 minutes at the same speed.

9. The number of correct answers given by Kaarmugilan and Kavitha in a quiz competition are in the ratio 10 : 11. If they had scored a total of 84 points in the competition, then how many points did Kavitha get?

10. Karmegan made 54 runs in 9 overs and Asif made 77 runs in 11 overs. Whose run rate is better? (run rate = ratio of runs to overs)

11. You purchase 6 apples for ₹90 and your friend purchases 5 apples for ₹70. Whose purchase is better?

Objective Type Questions

12. Which of the following ratios are in proportion?

    (a) 3 : 5 , 6 : 11   (b) 2 : 3, 9 : 6   (c) 2 : 5, 10 : 25   (d) 3 : 1, 1 : 3

13. If the ratios formed using the numbers 2, 5, x, 20 in the same order are in proportion, then 'x' is

    (a) 50   (b) 4   (c) 10   (d) 8

14. If 7 : 5 is in proportion to x : 25, then 'x' is

    (a) 27   (b) 49   (c) 35   (d) 14

15. If a barbie doll costs ₹90, then the cost of 3 such dolls is ₹ ____________.

    (a) 260   (b) 270   (c) 30   (d) 93

16. If a man walks 2 k.m. in 15 minutes, then he will walk __________ k.m. in 45 minutes.

    (a) 10   (b) 8   (c) 6   (d) 12

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Exercise 3.4

Miscellaneous Practice Problems

1. The maximum speed of some of the animals are given below :

   the Elephant = 20 k.m./h; the Lion = 80 k.m./h; the Cheetah = 100 k.m./h

   Find the following ratios of their speeds in simplified form and find which ratio is the least?.

   (i) the Elephant and the Lion (ii) the Lion and the Cheetah

   (iii) the Elephant and the Cheetah

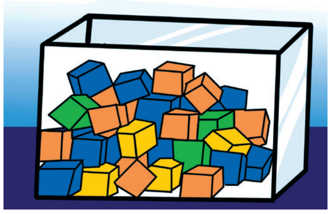
2. A particular high school has 1500 students 50 teachers and 5 administrators. If the school grows to 1800 students and the ratios are maintained, then find the number of teachers and administrators.

3. I have a box which has 3 green, 9 blue, 4 yellow, 8 orange coloured cubes in it.

   (a) What is the ratio of orange to yellow cubes?

   (b) What is the ratio of green to blue cubes?

   (c) How many different ratios can be formed, when you compare each colour to anyone of the other colours?



4. A gets double of what B gets and B gets double of what C gets. Find A : B and B : C and verify whether the result is in proportion or not.

5. The ingredients required for the preparation of Ragi Kali, a healthy dish of Tamilnadu is given below.

Ingredients	Quantity
Ragi flour	4 cups
Raw rice broken	1 cup
Water	8 cups
Sesame oil	15 ml
Salt	10 mg

   (a) If one cup of ragi flour is used then, what would be the amount of raw rice required?

   (b) If 16 cups of water is used, then how much of ragi flour should be used?

   (c) Which of these ingredients cannot be expressed as a ratio? Why?

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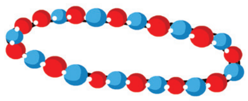
Challenging Problems

6. Antony brushes his teeth in the morning and night on all days in a week. Shabeen brushes her teeth only in the morning. What is the ratio of the number of times they brush their teeth in a week?

7. Thirumagal's mother wears a bracelet made of 35 red beads and 30 blue beads. Thirumalgal wants to make smaller bracelets using the same two coloured beads in the same ratio. In how many different ways can she make the bracelets?



8. Team A wins 26 matches out of 52 matches. Team B wins three-fourth of 52 matches played. Which team has a better winning record?

9. In a school excursion, 6 teachers and 12 students from 6th standard and 9 teachers and 27 students from 7th standard, 4 teachers and 16 students from 8th standard took part. Which class has the least teacher to student ratio?

10. Fill the boxes using any set of suitable numbers 6 : ☐ : : ☐ : 15.

11. From your school diary, write the ratio of the number of holidays to the number of working days in the current academic year.

12. If the ratio of Green, Yellow and Black balls in a bag is 4 : 3 : 5, then

    (a) Which is the most likely ball that you can choose from the bag?

    (b) How many balls in total are there in the bag if you have 40 black balls in it?

    (c) Find the number of green and yellow balls in the bag.

Summary

- A ratio is a comparison of two quantities by division.
- Ratios are often expressed as fractions in the simplest form.
- A ratio has no unit.
- The two quantities of a ratio should be in the same unit.
- Order of the terms in a ratio cannot be reversed.
- To get an equivalent ratio, multiply or divide the numerator and denominator by the same number.
- When two ratios are equal, they are said to be in proportion.
- The proportionality law states that the product of the extremes is equal to the product of the means.
- Finding the value of required number of units by knowing the value of one unit is known as unitary method.

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ICT Corner

RATIO AND PROPORTION

Expected Result is shown in this picture

Step – 1

Open the Browser, Copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

GeoGebra worksheet named “Ratio and Proportion” will open. Two sets of Coloured beads will appear.

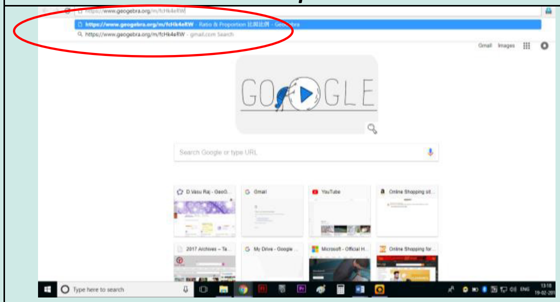
Step-3

Find the ratio of coloured beads for each pair. You can Increase or decrease the no’s by pressing “+” and “-“ button appearing on the right side of the page.

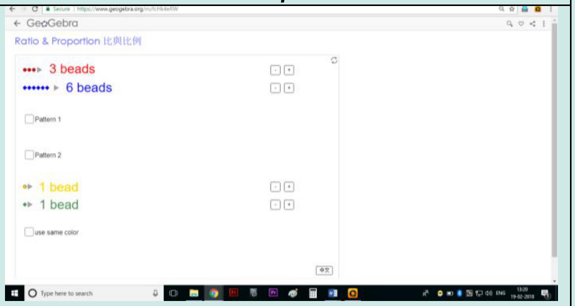
Step-4

To check your answer Press on “Pattern 1” and “Pattern 2” button. Repeat the test by increasing and decreasing the beads.

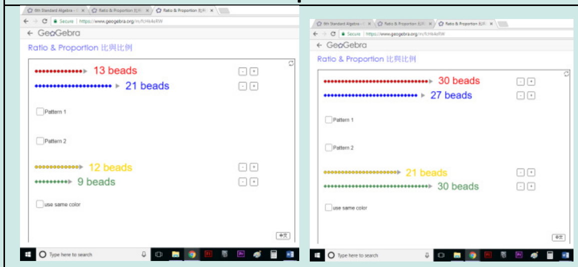
.Step-1



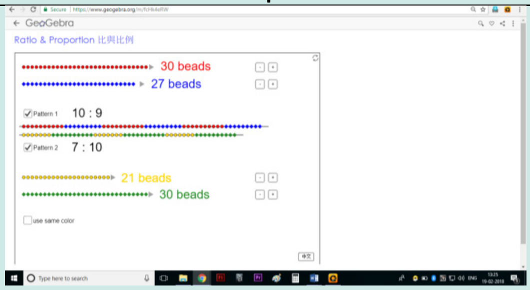
Step-2



Step-3



Step-4



Browse in the link

Ratios: - https://www.geogebra.org/m/fcHk4eRW

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Chapter 4

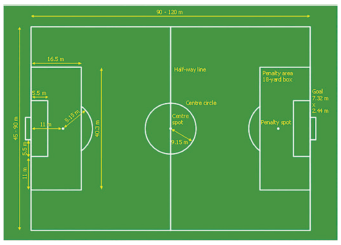
GEOMETRY

Q785C

Learning Objectives

- To know about lines, line segments and rays.
- To know angles and its types.
- To know the usage of ruler and protractor.
- To identify parallel and intersecting lines.
- To identify pairs of complementary and supplementary angles.
- To know collinear points and point of concurrency.

4.1 Introduction



Geometry means the measurement of the earth. It includes the study of the properties of shapes and its measures. In ancient days, geometry was developed for the practical purpose of construction, surveying and various crafts.

Nature evolves out of simple geometrical shapes and patterns from tiny atoms to huge galaxies. The objects that you see in your environment have an impact of geometrical ideas. An appealing appearance of houses and buildings are made possible by geometrical thinking. Vehicles like cycle, car, bus are designed using geometrical concepts. The toys that you play with, the tools like pencil, scale and book that you use with, give rise to geometrical ideas and shapes.

In this chapter, we will learn about the geometrical concepts such as lines, line segments, rays and angles.

MATHEMATICS ALIVE – NATURE'S GEOMETRIC MASTERPIECES

Hexagon in Honey Comb

Art of Geometric Patterns

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4.1.1 Fun with lines

What shapes can you draw with 3 lines or 4 lines or 5 lines?
We have already seen some shapes with names like triangles, rectangles and squares.

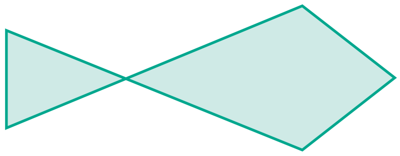


Fig. 4.1

Here is a shape which is in the form of a fish (see Fig. 4.1).
It has 5 lines. Can you draw a fish with 4 lines or with 3 lines? Think!

4.1.2 Only two lines

What shapes can you draw with only TWO lines?
The following forms are possible with 2 lines. Isn't it?

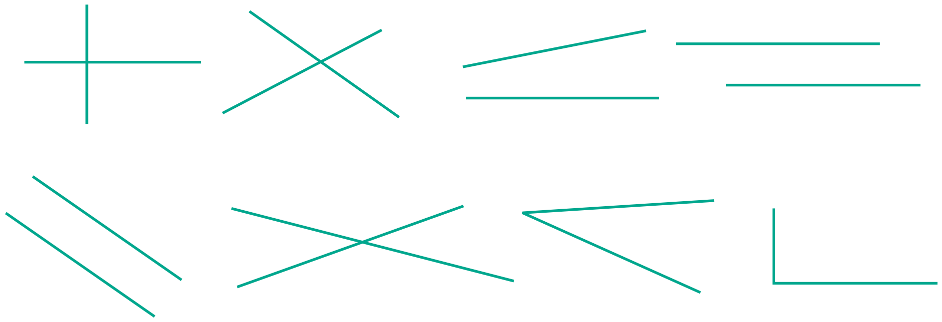


Fig. 4.2

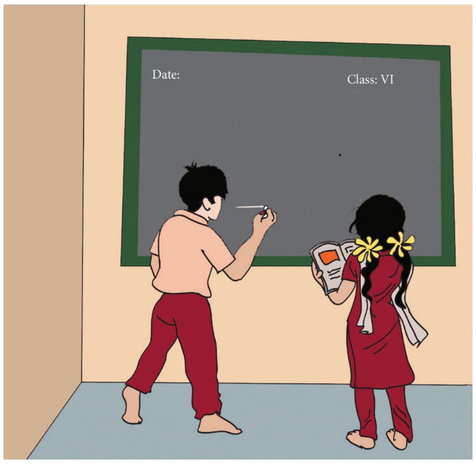
Is there something you notice in all these shapes?

4.1.3 Only one line

What shapes can be drawn with only ONE line? The line may be standing upright, lying flat, or slanting. Perhaps it can be, slant left or slant right. It may be long or short.

Now, consider the following situation.

The teacher gives Yazhini a paper with a line drawn on it and asks Akilan to draw the same line on the black board, as instructed by Yazhini. Then they shall reverse the process. They do the same with other shapes using 2 lines and 3 lines. Try doing this and say, whether this is easy to do!



Observe the following conversation.

Teacher : Sakthi, can you say how to draw lines?

Sakthi : Yes Teacher! Why only lines? I may like to draw curves and circles too!

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Teacher : Sakthi, you can do all the shapes you like. But you see, there is enough difficulty in describing shapes made only of lines. So, we will get to curves and circles later.

Sakthi : Teacher, Why should we describe shapes? We can just draw and show them when we want.

Is Sakthi right?

In Mathematics, every thinking is interesting and unlimited. Remember numbers; it is not stopped with adding 2 – digits. Numbers go on endlessly and it is possible to add any two numbers, however large. We know that even a 37- digit number ending in 0 is divisible by 5.

It is the same with shapes too. We are interested in lines, triangles, rectangles and in whatever the shapes may be and the size however large or small. We need to give them names not only to describe them but also to explore a lot with them.

4.2 Describing lines

A line can be long or short. A line can be flat or slant or vertical. If a line is rotated in any direction, it remains to be a line. So, given below (Fig. 4.3) are lines in different positions.

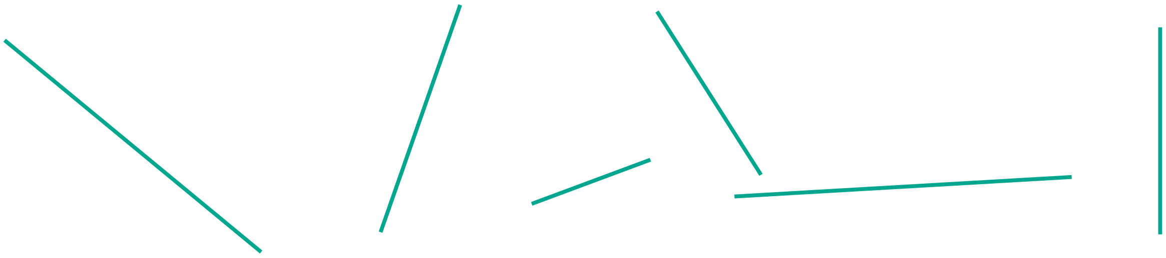

Fig. 4.3

But the following (Fig.4.4) are not straight lines.

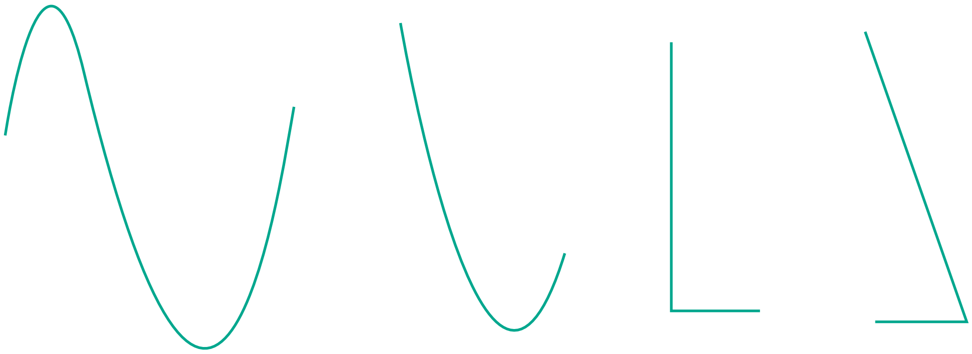

Fig. 4.4

If the length of a line is ignored, then it can be extended in both the directions without ending as in (Fig. 4.5) given below. A line through two points A and B is written as $\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$. Also it is denoted by a letter 'l'.

Fig. 4.5

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4.2.1 Line segment

What do we call a line that is short and ends on both sides? That we call it as a line segment and name both of its ends with letters as shown in fig. 4.6.

Fig. 4.6

We usually use CAPITAL LETTERS to denote the ends of the line segments. A line segment is denoted by $\overline{AB}$. What can we do with a line segment? We can measure its length. Given two line segments, we can compare their lengths and say which is shorter and which is longer.

Even if we measure length as a number, we get lots of line segments, each with a definite length. Using a ruler, we can draw the following line segments.

1 cm A ——— B

2 cm A ————— B

3 cm A ——————— B

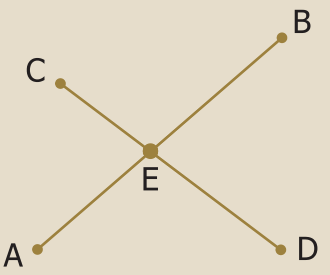
...

10 cm A ——————————————————— B

What about a line segment of length 17 cm or 20 cm or 30 cm or 378 cm? Like, numbers never end, line segments get longer and longer forever!

TRY THIS

Name all the line segments.



4.2.2 Construction of line segment

Learn to measure line segments using the ruler.

Correct way of viewing the scale.

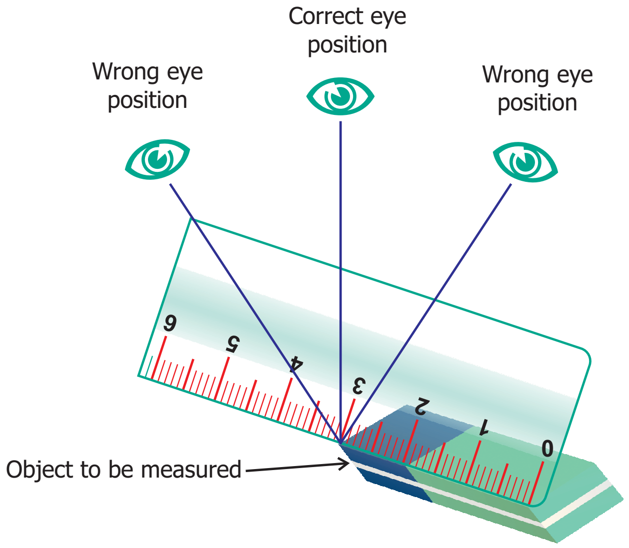


Fig. 4.7

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Examples of Measuring Line Segments

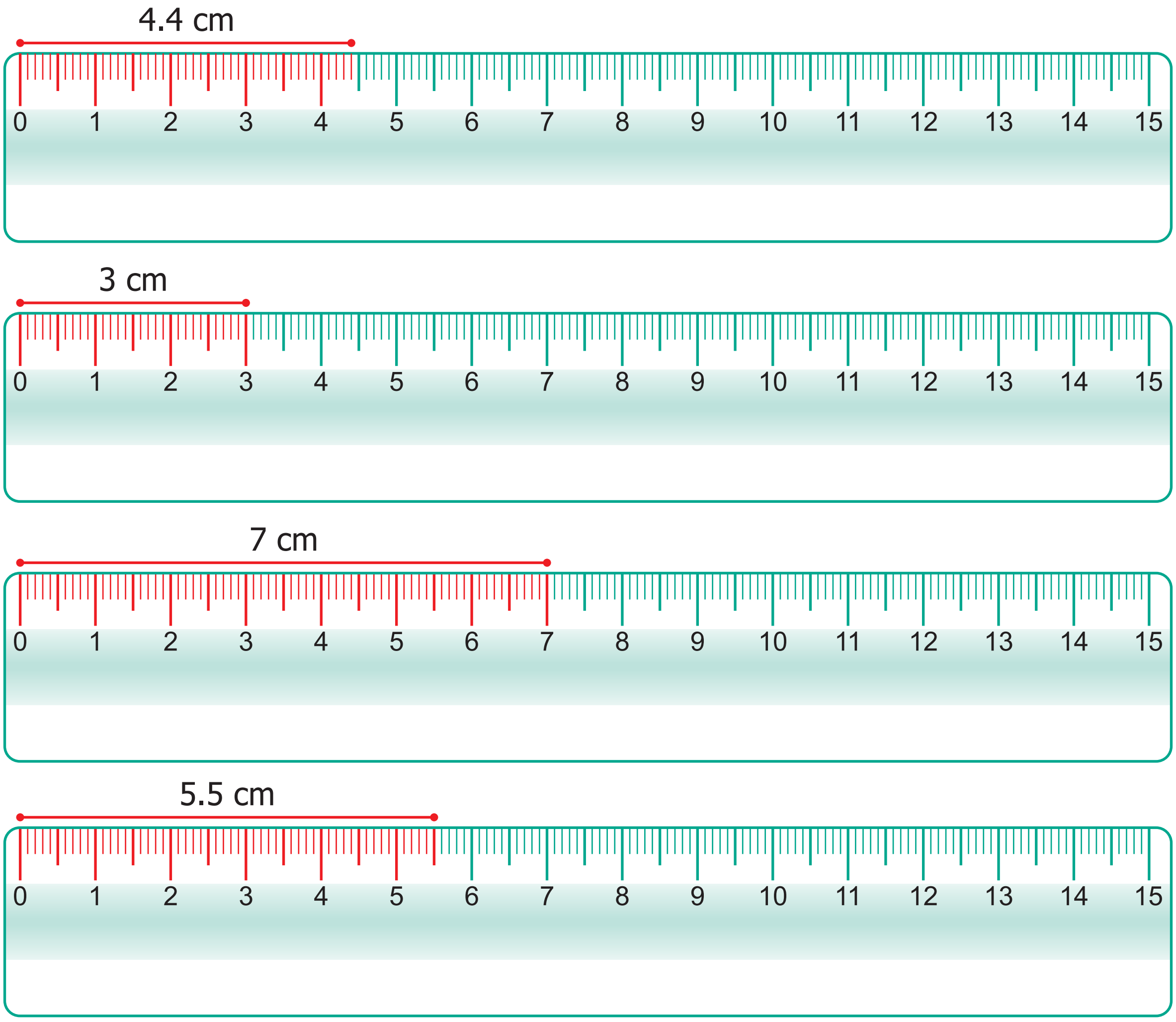

Fig. 4.8

TRY THIS

If AB = 5cm, say which of the measures are correct in fig. 4.9.

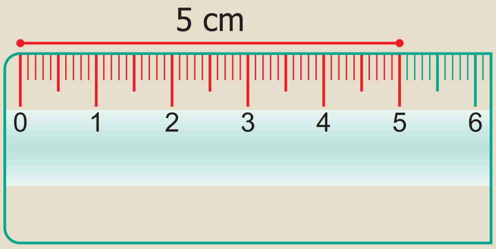

Fig. 4.9 (i)

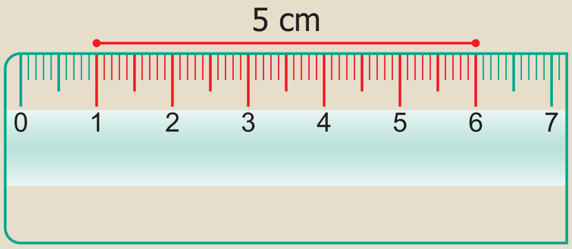

Fig. 4.9 (ii)

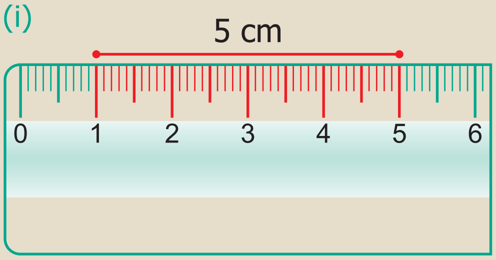

Fig. 4.9 (iii)

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DO YOU KNOW?

Geometry originated from two Greek words, geo, meaning earth and metron meaning measure. Geometry means earth measure. Around 600 B.C.(BCE), Thales of Miletus was the first to use deductive methods to develop geometric concepts. The Greek Mathematician, Pythagoras continued the systematic development of Geometry.

Example 4.1

With the help of a ruler and compass, draw a line segment PQ = 5.5cm.

Solution

- Draw a line 'l' and mark a point 'P' on it as shown in Fig. 4.10.

Fig. 4.10

- Measure 5.5 cm using compass as shown in Fig. 4.11 placing the pointer at '0' and the pencil pointer at 5.5 cm.

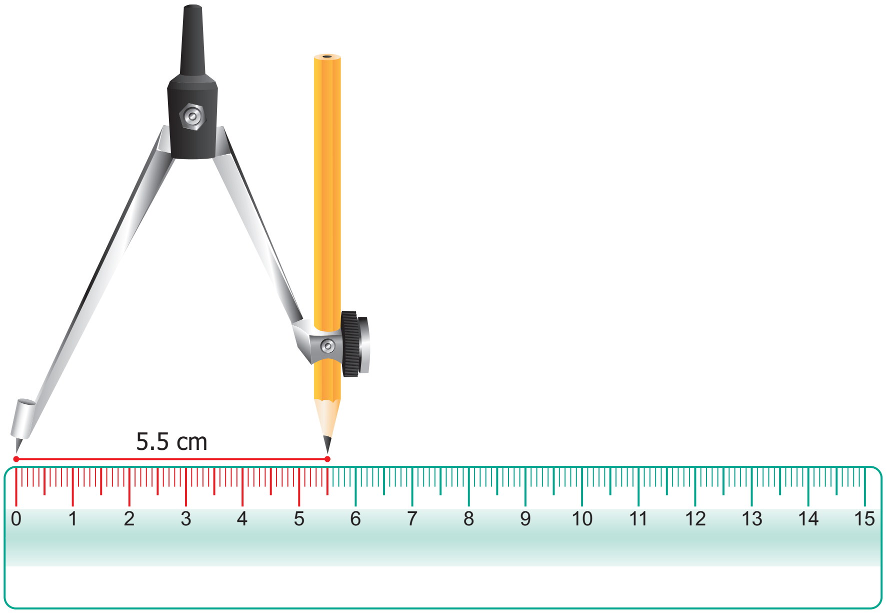

Fig. 4.11

- Place the pointer of the compass at ' P ' then draw a small arc on the line 'l' with the pencil pointer (Fig. 4.12). It cuts the line 'l' at a point and name that point as 'Q' (Fig. 4.13).

Fig. 4.12

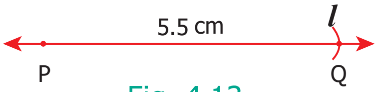

Fig. 4.13

- Now, PQ is the required line segment of length 5.5 cm.

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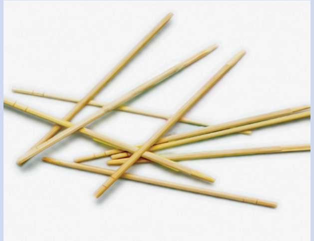
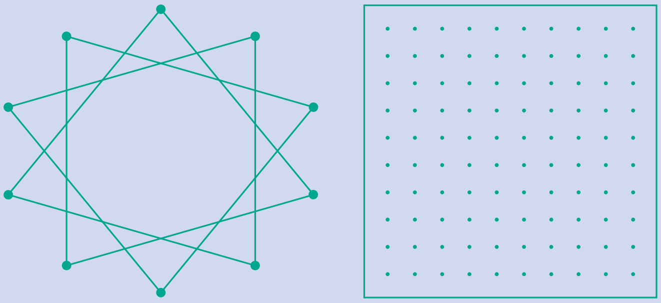
ACTIVITY

This game can be played in small groups. Take 10 or more sticks of equal length. Join them as a bundle and put them on the floor in such a way that they fall one above the other. The challenge is to take one stick after other without disturbing the position of the other sticks.



ACTIVITY



Enjoy trying kolams using line segments!

4.2.3 Two lines

Now let us get back to two lines (Fig. 4.14). Lines that go on forever on either side without meeting each other (i.e. they have a constant distance in between) are called parallel lines.

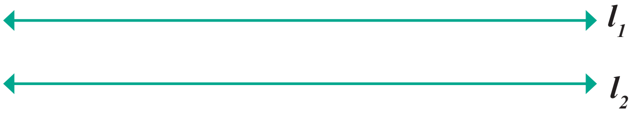


Fig. 4.14

Thus, parallel lines go forever without meeting.

What will happen if two lines are not parallel?

Then they must meet somewhere! Of course, they go their way after meeting too.

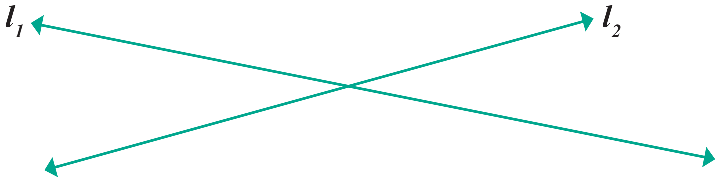


Fig. 4.15

Here, l_1 and l_2 are called intersecting lines.

Of course, we now have parallel line segments and intersecting line segments too.

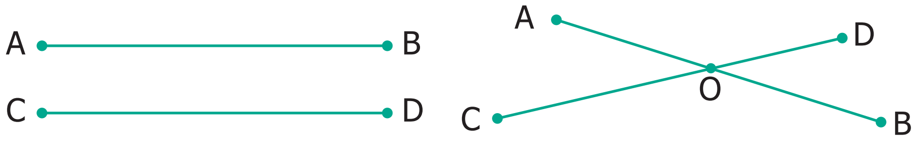


Fig. 4.16

The position 'O' at which the line segments $\overline{AB}$ and $\overline{CD}$ meet is called their point of intersection.

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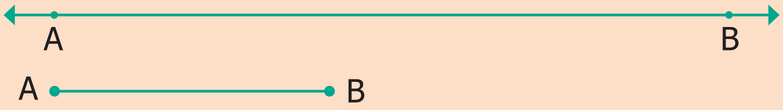
ACTIVITY

Take a piece of paper and fold in as many ways as you can, which generates parallel lines or intersecting lines.

A few examples are shown for you.

NOTE

A line has no end points, whereas a line segment has end points. We can measure the length of a line segment.



4.2.4 Rays

What about lines that end on one side but proceed indefinitely on the other side? We call them rays. They are denoted by $\overrightarrow{AB}, \overrightarrow{PQ}, \overrightarrow{MN}$..., etc. The fixed end point of a ray is called the starting point. (See fig.4.17)

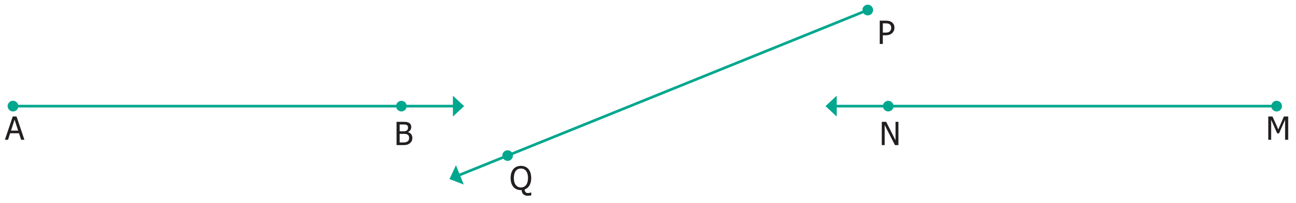


Fig. 4.17

4.2.5 Two rays

With two rays we have more to learn. They can be parallel or intersecting.

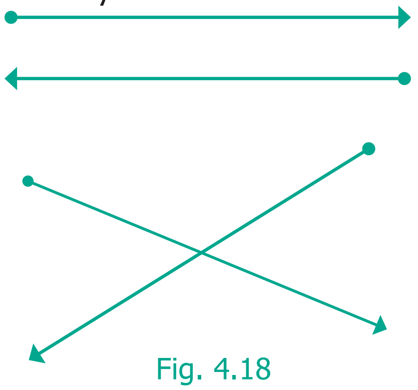


Fig. 4.18

Two rays may have the same starting point.

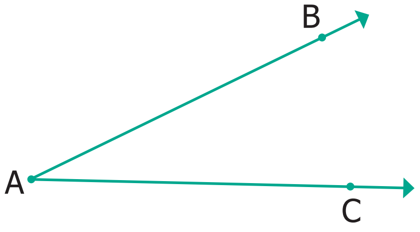
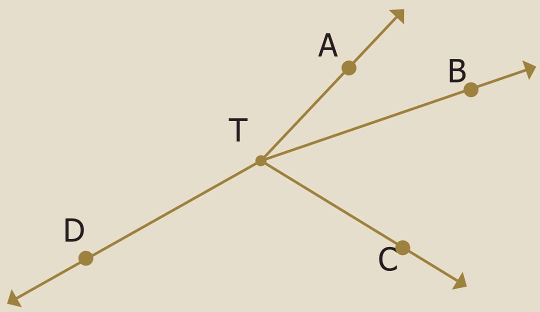


Fig. 4.19

TRY THIS



- Name the rays in the given figure.
- What is the common point of all these rays?

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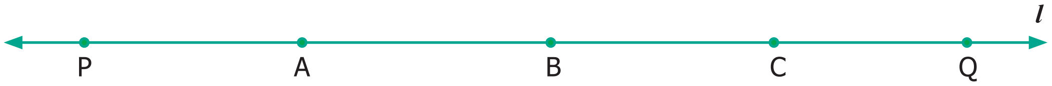
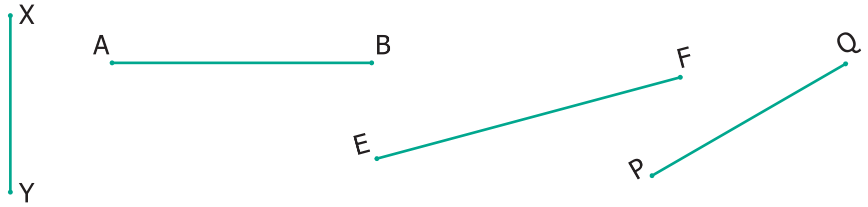
Exercise 4.1

1. Fill in the blanks.
   (i) A line through two end points 'A' and 'B' is denoted by ____________.
   (ii) A line segment from point 'B' to point 'A' is denoted by ____________.
   (iii) A ray has ____________ end point(s).

2. How many line segments are there in the given line? Name them.

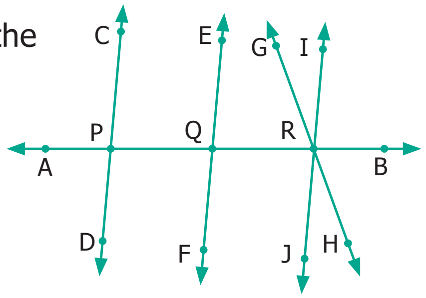


3. Measure the following line segments.

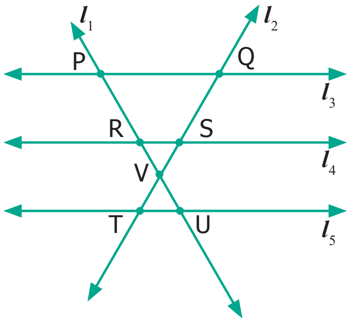


4. Construct a line segment using ruler and compass.
   (i) AB = 7.5 cm (ii) CD = 3.6 cm (iii) QR = 10 cm

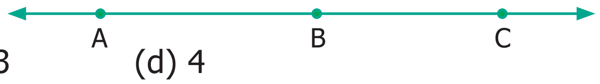
5. From the given figure, name the
   (i) parallel lines
   (ii) intersecting lines
   (iii) points of intersection.



6. From the given figure, name
   (i) all pairs of parallel lines.
   (ii) all pairs of intersecting lines.
   (iii) pair of lines whose point of intersection is 'V'.
   (iv) point of intersection of the lines 'l_2' and 'l_3'.
   (v) point of intersection of the lines 'l_1' and 'l_5'.



Objective Type Questions

7. The number of line segments in  is

   (a) 1 (b) 2 (c) 3 (d) 4

8. A line is denoted as
   (a) AB (b) $\overrightarrow{AB}$ (c) $\overleftrightarrow{AB}$ (d) $\overline{AB}$

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4.3 Angles

Can we find a way to describe all these shapes? (shown in fig. 4.20)

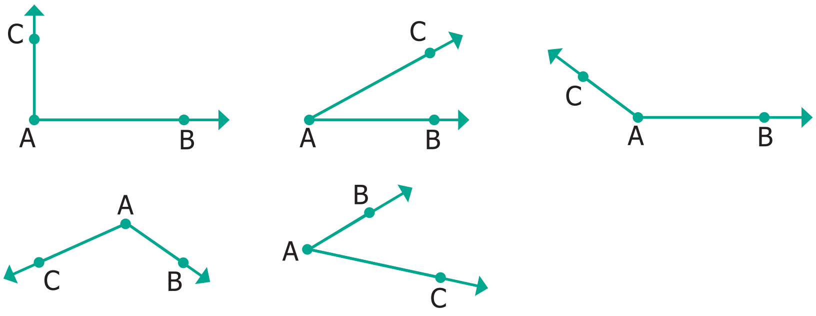
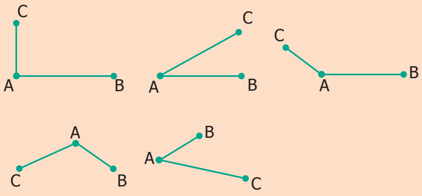


Fig. 4.20

NOTE

We can do the same with two line segments also. See the figures given below.



How would you describe whether a ray (or line segment) is vertical or slanting with respect to another ray (or line segment)?

DO YOU KNOW?

Carrom board involves many geometric concepts like line segments and angles. When the striker hits the coin, the coin moves in a straight line. When the striker or coins hit the board end they make angles with the board while returning.

When two rays or line segments meet at their end points, they form an angle at that point.

Fig. 4.21

In the Fig.4.21 rays $\overrightarrow{AB}$ and $\overrightarrow{AC}$ are the sides and 'A' is the vertex which is the meeting point of both the line segments.

4.3.1 Naming Angles

We name the angle as shown in the Fig.4.22 below.

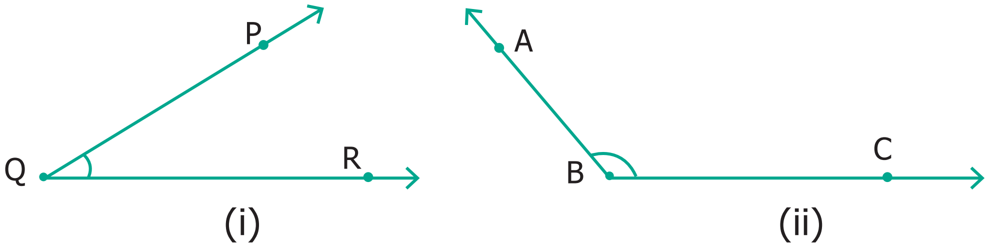


Fig. 4.22

Fig 4.22(i) shows the angle $\angle PQR$; $\overrightarrow{QP}$, $\overrightarrow{QR}$ are its sides. 'P' is on $\overrightarrow{QP}$; 'R' is on $\overrightarrow{QR}$.

Fig 4.22(ii) shows the angle $\angle ABC$; $\overrightarrow{BA}$, $\overrightarrow{BC}$ are its sides. 'A' is on $\overrightarrow{BA}$; 'C' is on $\overrightarrow{BC}$.

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We name the angle in fig. 4.22 (i) as ∠Q or ∠PQR or ∠RQP . Similarly, in Fig. 4.22 (ii), we may write ∠B as ∠ABC or ∠CBA.

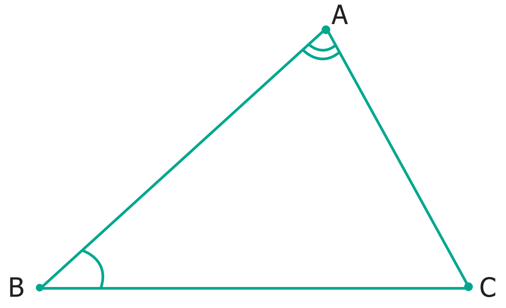


Fig. 4.23

In the Fig. 4.23, two angles are marked.

Note that ∠BAC is not the same as ∠ABC,

as they have different vertices and different sides

4.3.2 Measuring Angles

Can we measure angles too? Yes, using protractor they are measured in degrees which are denoted by the symbol ‘ o ’. This has to be marked at top right of a number. We write angles as 35°, 78°, 90°, 110°, 145° and so on.

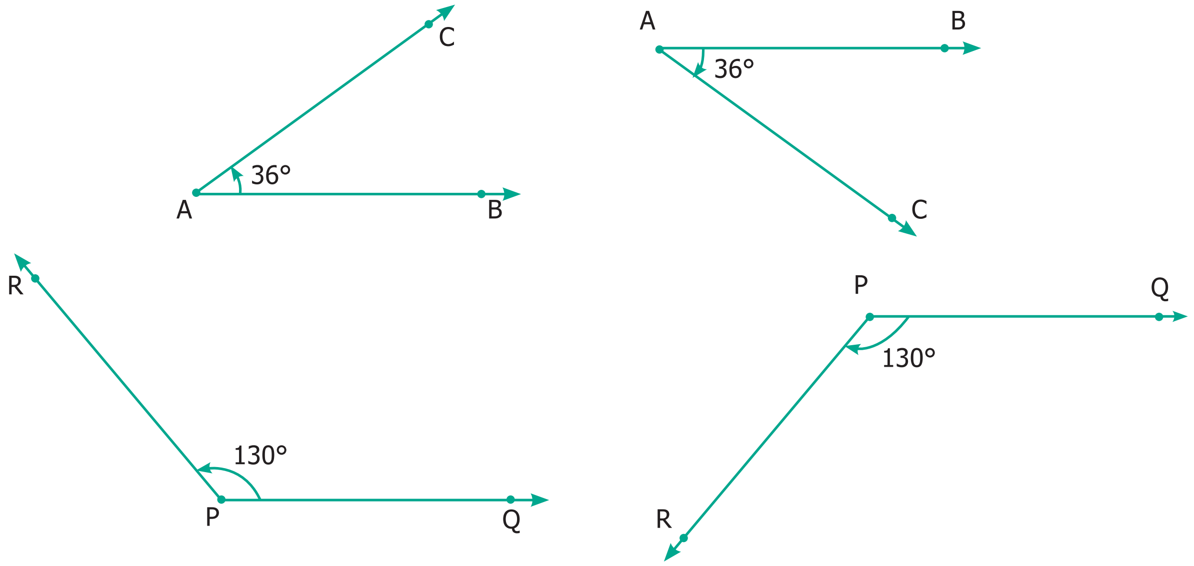


Fig. 4.24

See that angles can be equal even if they are positioned differently.

4.3.3 Special Angles

Some angles are special. 90° is one such. We call it as the right angle.

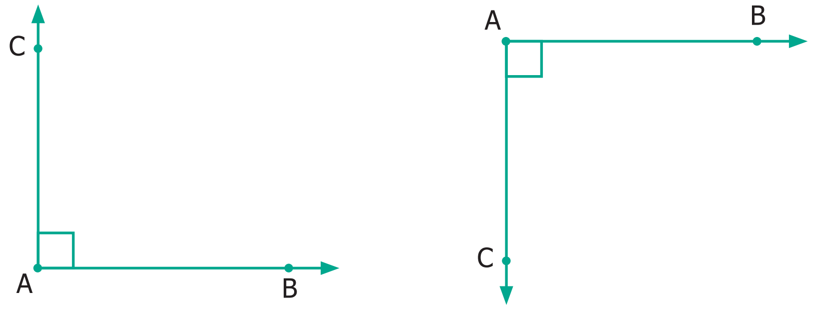


Fig. 4.25

Right angle is most common in life. Examples can be seen at cross-roads, chess board, TV, etc.

Acute Angles

Fig. 4.26

Each of the angles in the above Fig. 4.26 is less than a right angle. Angles smaller than 90° are called Acute angles.

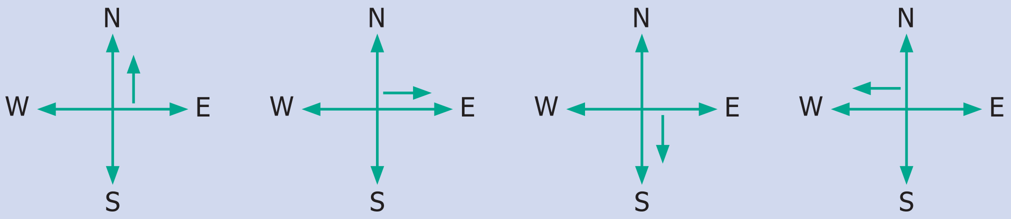
Obtuse Angles

$\overrightarrow{AB}$ $\overrightarrow{AC}$ Fig. 4.27

Each of the angles in the above Fig. 4.27 is greater than right angle. If an angle is more than 90° and less than 180° is called an obtuse angle.

ACTIVITY

Stand facing the north side. Take a 'right angle turn' clockwise; you now face east. Again take another 'right angle turn' in the same direction. You now face south. Once again take another 'right angle turn' in the same direction. You now face west. Then follow the same you will come to the original position. Thus the complete turn is called one revolution. The turn from north to south will be two right angles. It is also called a straight angle. Two straight angles make one complete revolution. This is illustrated in the following figures.



TRY THESE

1. Which direction will you face if you start facing West and take three right turns clockwise?
2. Which direction will you face if you start facing North and take two right turns anti-clockwise?

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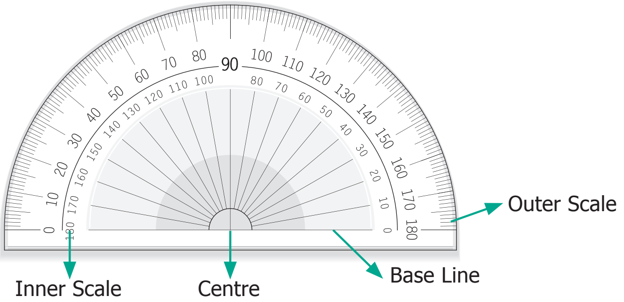
4.3.4 Angle measurement using Protractor

How do we measure an angle? Using a PROTRACTOR we can measure an angle.



A protractor has one centre and a base line. It has two scales namely, inner scale from 0° to 180° in anti clockwise direction and outer scale from 0° to 180° in the clockwise direction. Why does the protractor stop with 180°? We can rotate the protractor and measure, so 180° is enough.

Steps To Measure an angle

Step 1: Place the centre of the protractor on the vertex of the angle and line up the base line with 0°.

Step 2: Read the measure where the other ray crosses the protractor.

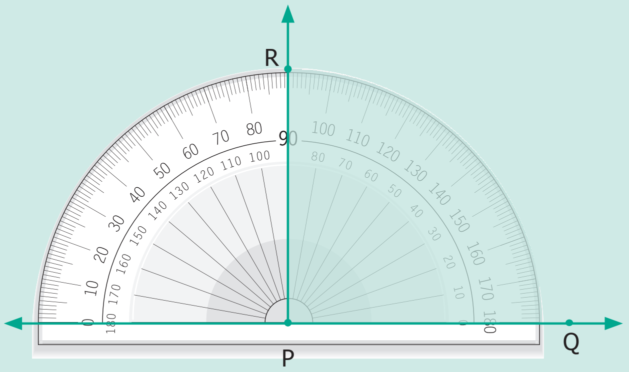
4.3.5 Using Protractor to draw Right Angle (90°)

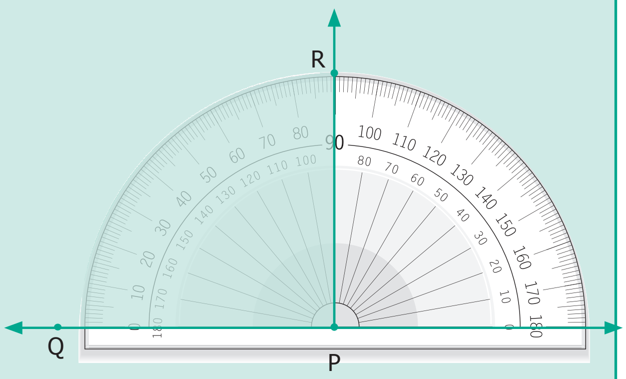
Example 4.2

Use a Protractor to draw an angle 90°.

<table>
<tr><td>Draw base ray

</td><td>Draw base ray

</td></tr>
<tr><td>

Place the center of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0° line. Then draw and label a point (R) at the 90° mark on the inner scale (anticlockwise)</td><td>

Place the center of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0° line. Then draw and label a point (R) at the 90° mark on the outer scale (clockwise)</td></tr>
</table>

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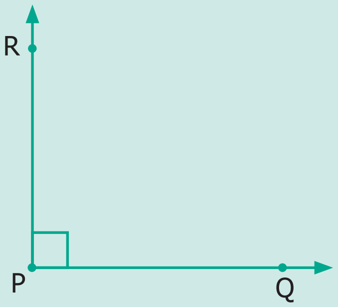
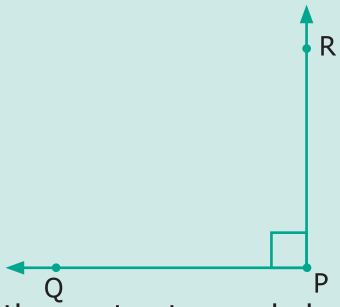


Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle.

Now, ∠P = ∠QPR = ∠RPQ =90°



Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle.

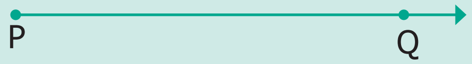
Now, ∠P = ∠QPR = ∠RPQ =90°

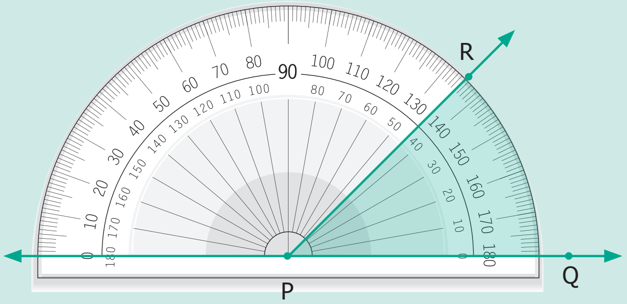
4.3.6 Using Protractor to draw an Acute Angle

Example 4.3

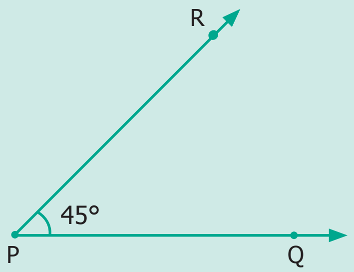
Use a Protractor to draw an angle 45°.

Draw base ray





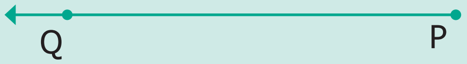
Place the centre of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0º line. Then draw and label a point (R) at the 45° mark on the inner scale (anticlock wise)

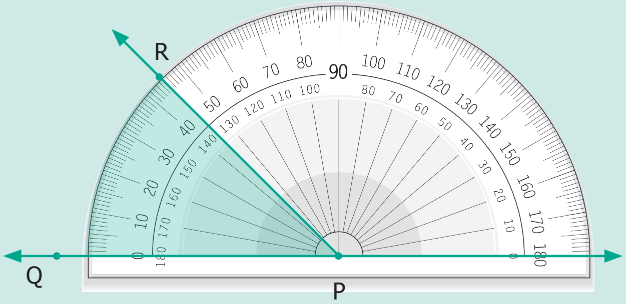


Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle.

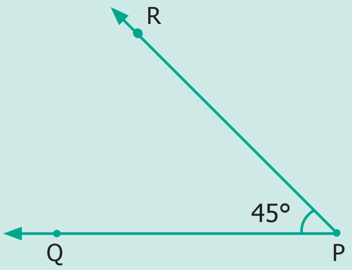
Now, ∠P = ∠QPR = ∠RPQ =45°

Draw base ray





Place the centre of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0º line. Then draw and label a point (R) at the 45° mark on the outer scale (clock wise)



Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle.

Now, ∠P = ∠QPR = ∠RPQ =45°

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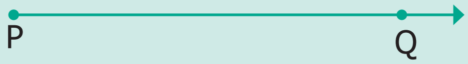
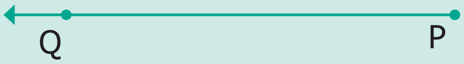
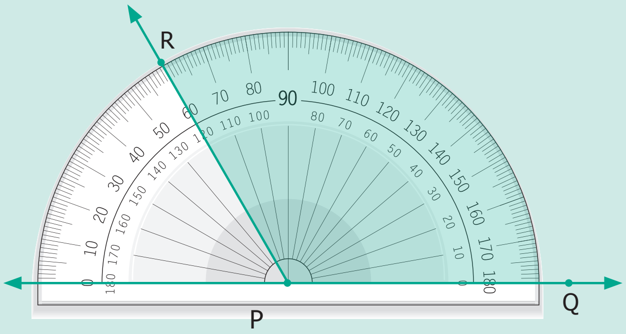
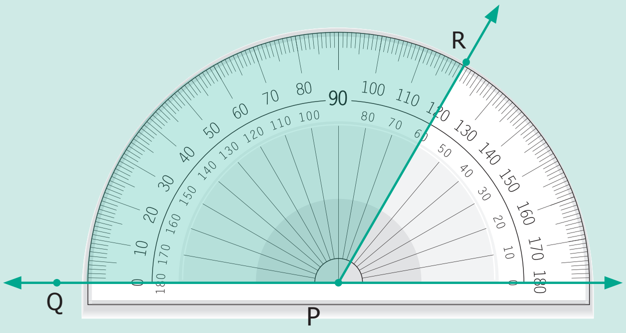
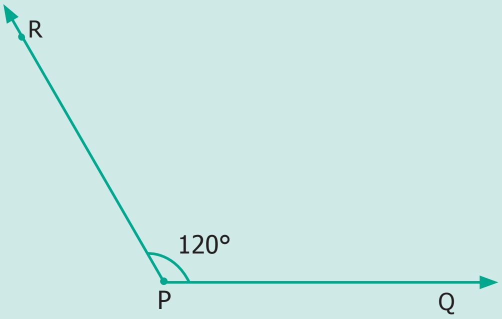
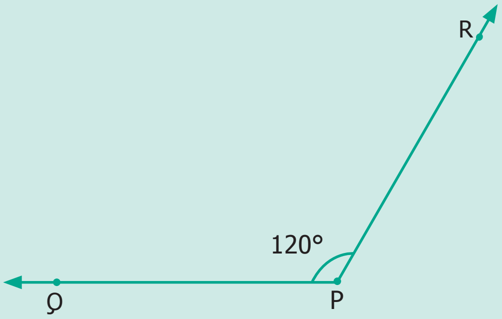
4.3.7 Using Protractor to draw an Obtuse Angle

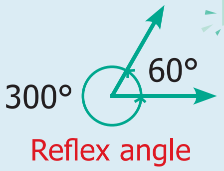
Example 4.4

Use a protractor to draw an obtuse angle 120°.

Draw base ray	Draw base ray
	
	
Place the centre of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0° line. Then draw and label a point (R) at the 120° mark on the inner scale (anti clock wise)	Place the centre of the protractor at the vertex P. Line up the ray $\overrightarrow{PQ}$ with the 0° line. Then draw and label a point (R) at the 120° mark on the outer scale (clock wise)
	
Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle. Now, ∠P = ∠QPR = ∠RPQ =120°	Remove the protractor and draw $\overrightarrow{PR}$ to complete the angle. Now, ∠P = ∠QPR = ∠RPQ =120°

DO YOU KNOW?

Reflex angles are bigger than 180°. Always subtract the given angle from 360° to get the reflex angle.



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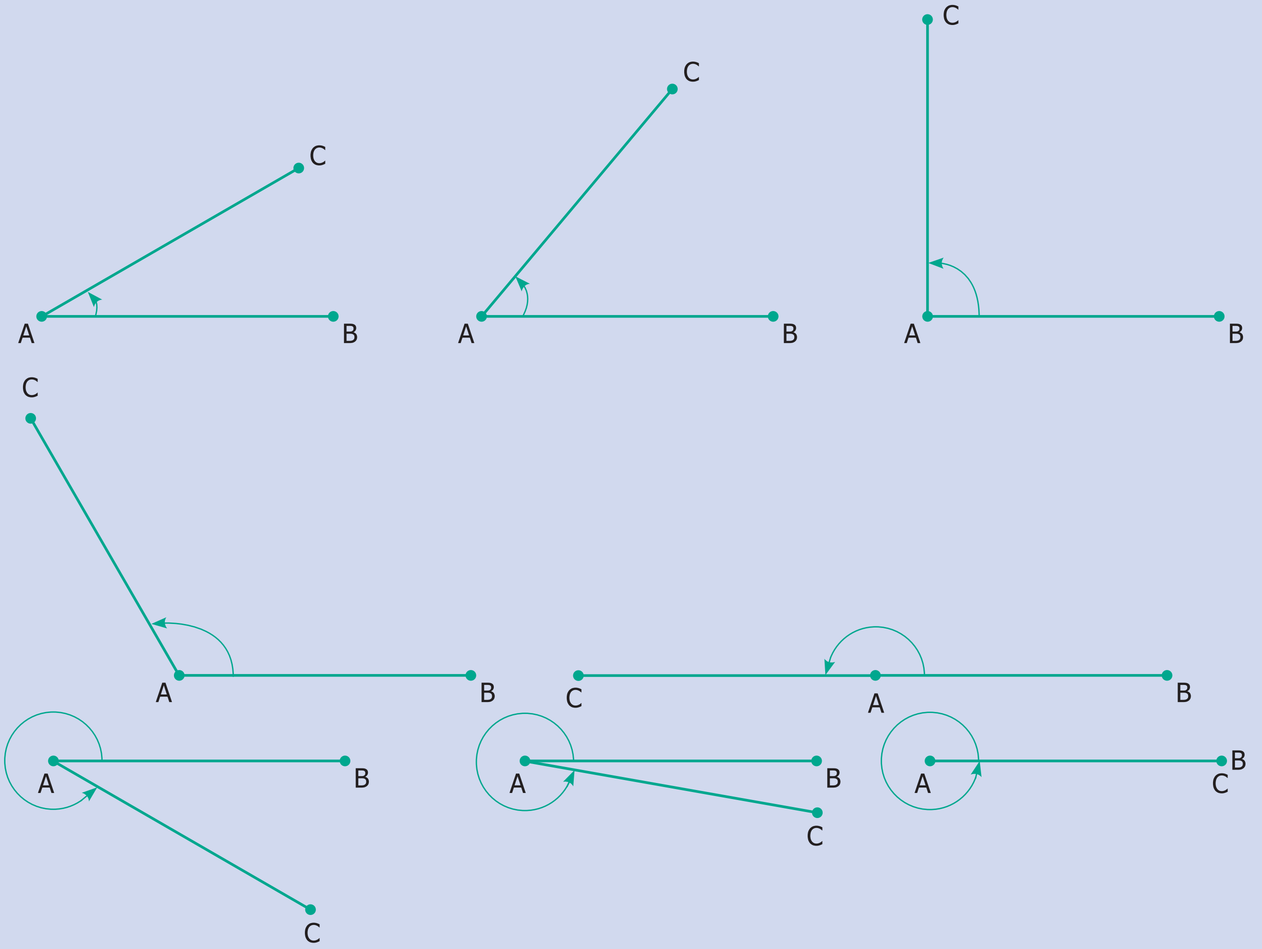
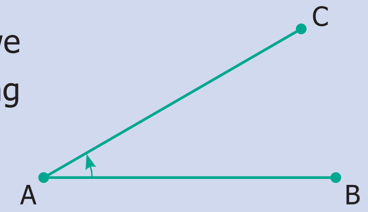
ACTIVITY

Fix a line segment $\overline{AB}$ and let's have another line segment $\overline{AC}$, go on rotating $\overline{AC}$ to the left.



In this rotations, At some point $\overline{AC}$ overlap $\overline{AB}$ and then we are back to the same as before. So angle, keep on increasing and after some point, return to 0º.



Is this familiar? Yes, you can see this in a clock!

TRY THIS

Adjust the hands of the clock for the following time, note the angle made between the hour hand and the minute hand and write the type of angle.

12.10	12.40	3.25	9.40	5.55	1.25	4.25	7.05
Acute angle							

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4.3.8 Very special angles

- Here you find $\overrightarrow{AC}$ is exactly on $\overrightarrow{AB}$; then the angle is 0°. It is called the Zero angle.

- If ‘C’ is exactly on the opposite side ‘B’, with vertex ‘A’ in the middle. Then the angle is 180°. It is called the Straight angle.

4.3.9 Special pairs of angles

Two angles are complementary to each other if they add upto 90° [See Fig. 4.28(i)]

Two angles are supplementary to each other if they add upto 180° [See Fig. 4.28(ii)]

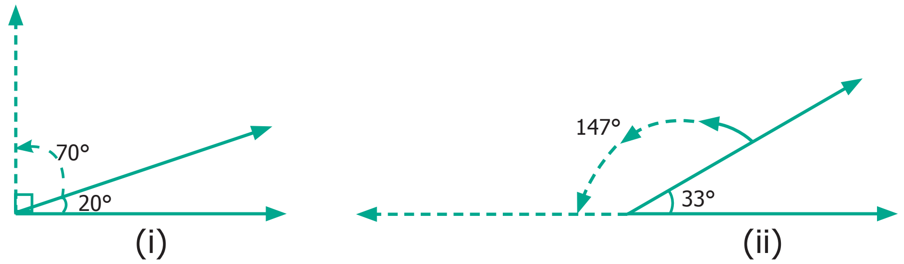

Fig. 4.28

In the above figures, 20° and 70° are complementary angles and 147° and 33° are supplementary angles. But 35° and 75° are neither complementary nor supplementary.

Exercise 4.2

1. Use any number of the given dots to make different angles.

1) An Acute Angle	2) An Obtuse Angle . . . .
3) A Right Angle	4) A Straight Angle . . . .

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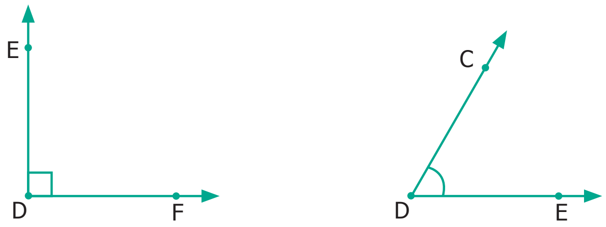
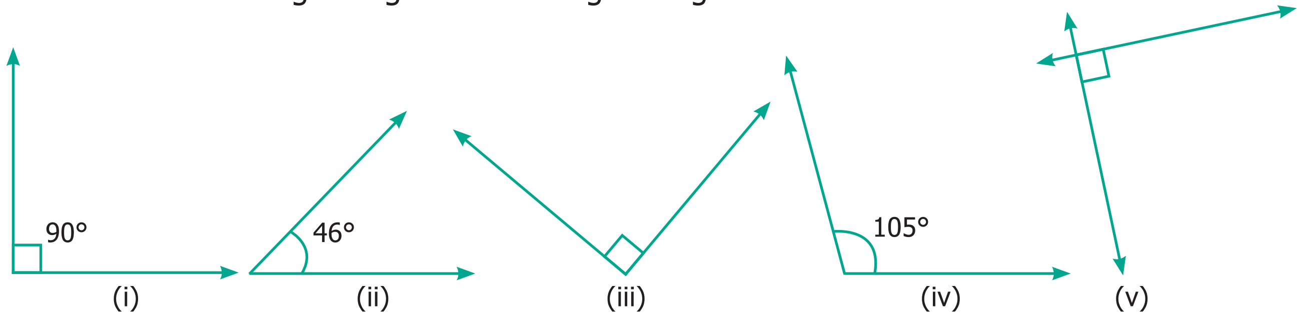
2. Name the vertex and sides that form each angle.



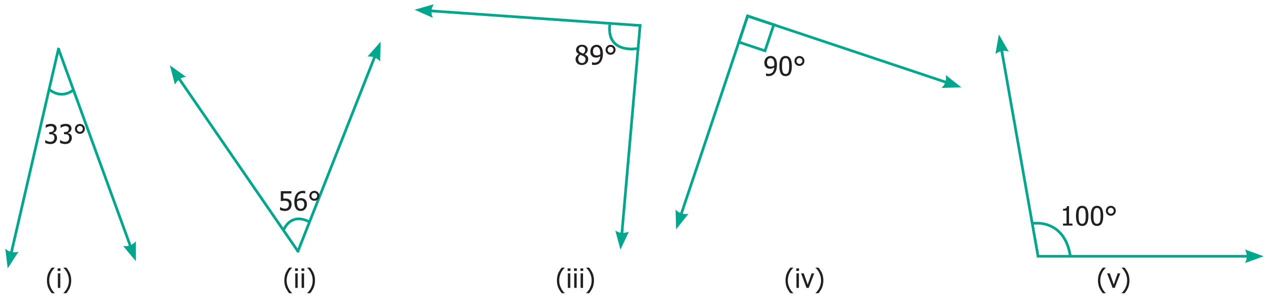
Vertex ______________ Vertex ______________

Sides ______________ Sides ______________

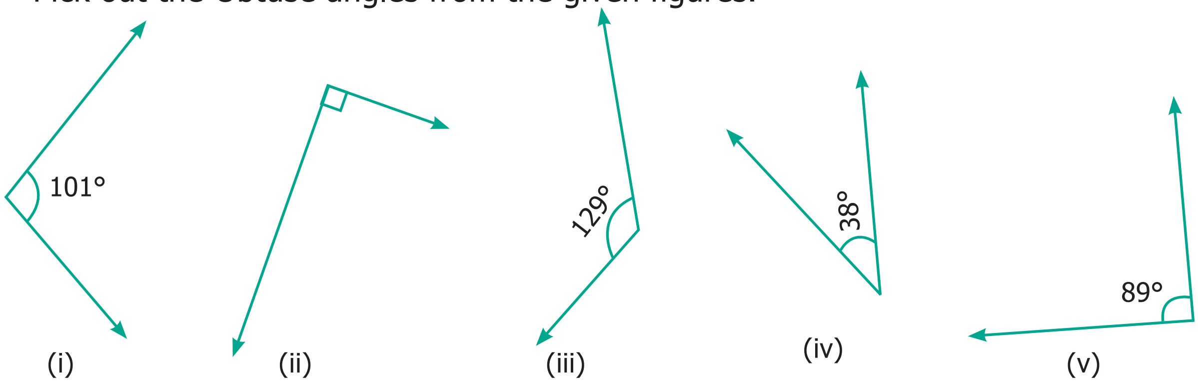
3. Pick out the Right angles from the given figures.



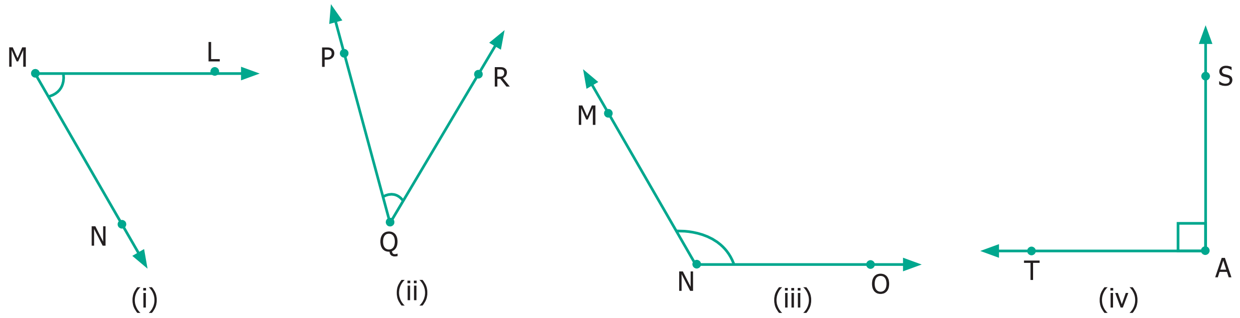
4. Pick out the Acute angles from the given figures.



5. Pick out the Obtuse angles from the given figures.



6. Name the angle in each figure given below in all the possible ways.



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7. Say True or False.

(i) 20° and 70° are complementary.

(ii) 88° and 12° are complementary.

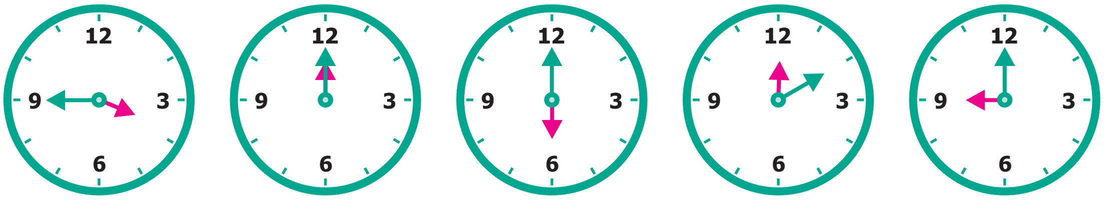
(iii) 80° and 180° are supplementary.

(iv) 0° and 180° are supplementary.

8. Draw and label each of the angles.

(i) $\angle NAS = 90°$ (ii) $\angle BIG = 35°$ (iii) $\angle SMC = 145°$ (iv) $\angle ABC = 180°$

9. Identify the types of angles shown by the hands of the given clock.



(i) (ii) (iii) (iv) (v)

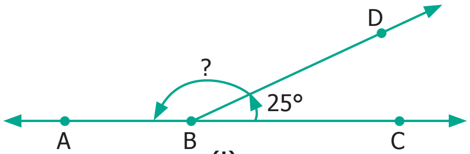
10. Find the complementary angle of

(i) 30º (ii) 26º (iii) 85º (iv) 0º (v) 90º

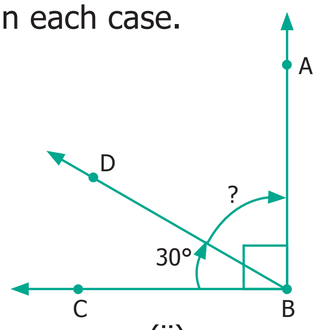
11. Find the supplementary angle of

(i) 70º (ii) 35º (iii) 165º (iv) 90º (v) 0º

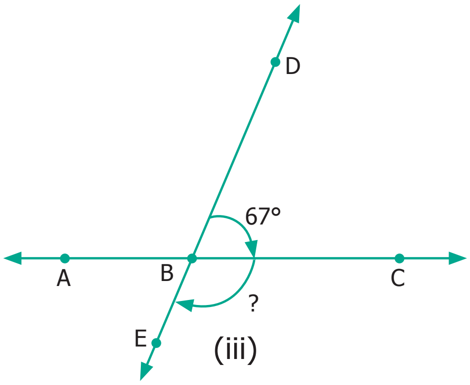
12. Find the supplementary / complementary angles in each case.



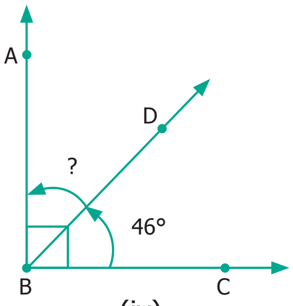
(i)



(ii)



(iii)



(iv)

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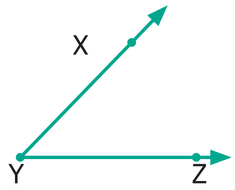
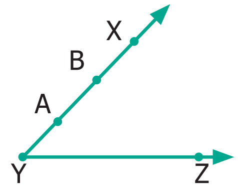
Objective Type Questions

13. In this Figure, which is not the correct way of naming an angle?



(a) ∠ Y (b) ∠ ZXY (c) ∠ ZYX (d) ∠ XYZ

14. In this Figure, ∠ AYZ = 45°. If point 'A' is shifted to point 'B' along the ray, then the measure of ∠ BYZ is ___________.



(a) more than 45° (b) 45° (c) Less than 45° (d) 90°

4.4 Points and lines

When we have a line, we can mark a point on the line or not on it.

Fig. 4.29

'A' is on 'l_1', 'B' is not on 'l_1' or 'l_2'. 'B' may be closer or far away, but not on the both of the lines 'l_1' and 'l_2'. However, when any two points are given, there is exactly ONE line passing through them! Take several pairs of points and verify if this is true.

What about 3 points and a line? Consider the following lines 'l_1' 'l_2' 'l_3' and 'l_4' and A,B,C be three points.

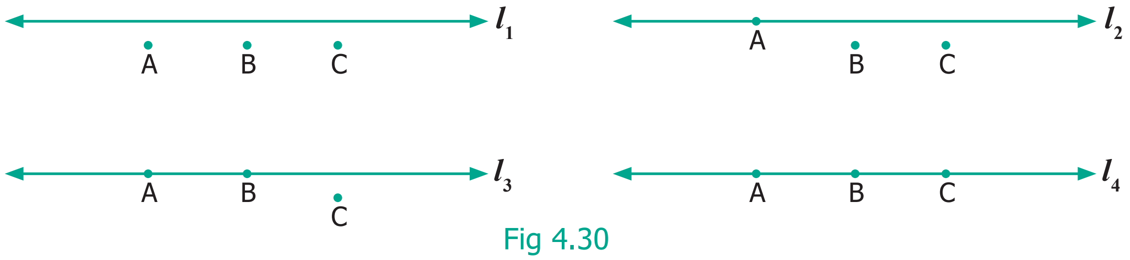


Fig 4.30

When all the three points are on a line, they are special; we call such points as collinear points.

When two lines intersect at right angles (90°), we call them as perpendicular lines. (Refer to 4.31)

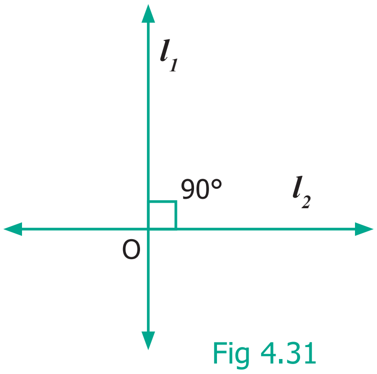


Fig 4.31

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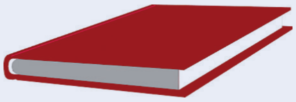
ACTIVITY

A book is an object where you can see parallel, perpendicular and intersecting lines.

Suggest atleast 2 more examples having parallel, perpendicular and intersecting lines.



Two intersecting lines cut at a point. Will three lines intersect at one point? Fig.4.32 will help you to answer this.

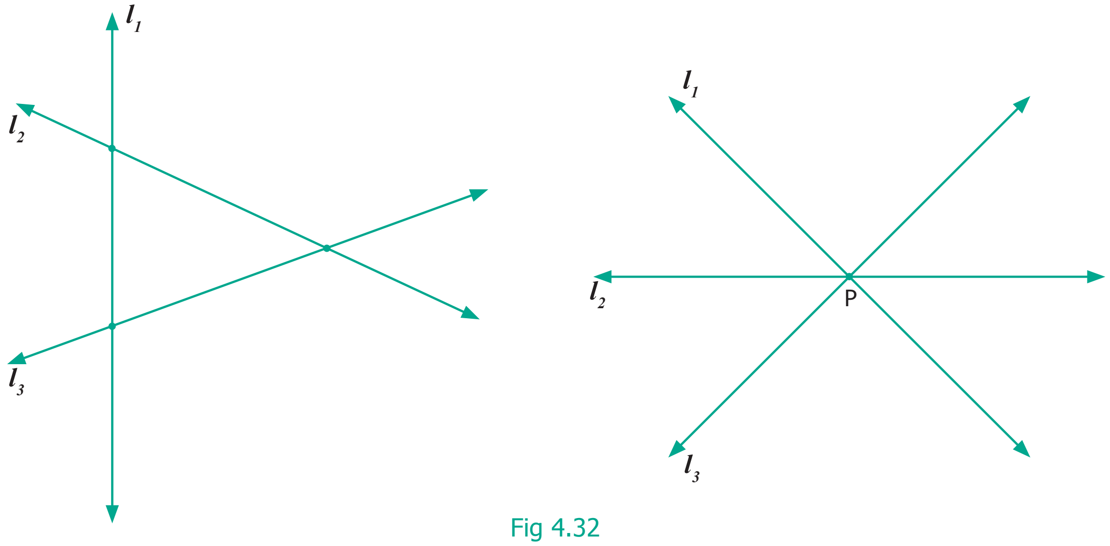
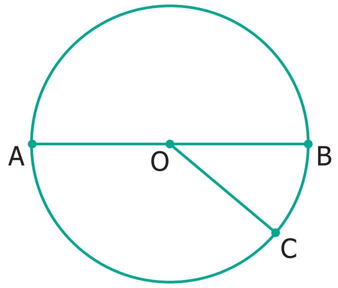


Fig 4.32

When many lines intersect at a single point, that is again special, we call that point P as a point of concurrency. The lines are called concurrent lines.

Exercise 4.3



1. Observe the diagram and fill in the blanks.
   (i) 'A', 'O' and 'B' are __________ points.
   (ii) 'A', 'O' and 'C' are __________ points.
   (iii) 'A', 'B' and 'C' are __________ points.
   (iv) __________ is the point of concurrency.
2. Draw any line and mark any 3 points that are collinear.
3. Draw any line and mark any 4 points that are not collinear.
4. Draw any 3 lines to have a point of concurrency.
5. Draw any 3 lines that are not concurrent. Find the number of points of intersection.

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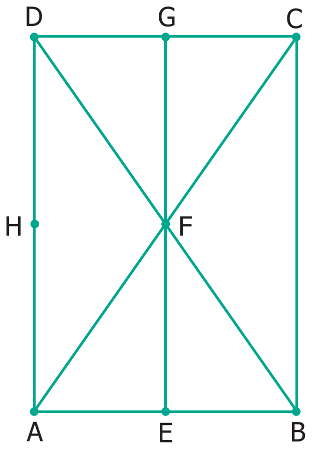
Objective Type Questions



6. A set of collinear points in the figure are __________.

   (a) A, B, C (b) A, F, C (c) B, C, D (d) A, C, D

7. A set of non-collinear points in the figure are __________.

   (a) A, F, C (b) B, F, D (c) E, F, G (d) A, D, C

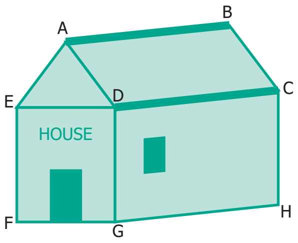
8. A point of concurrency in the figure is __________.

   (a) E (b) F (c) G (d) H

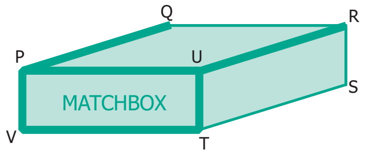
Exercise 4.4

Miscellaneous Practice Problems

1. Find the type of lines marked in thick lines (Parallel, intersecting or perpendicular).



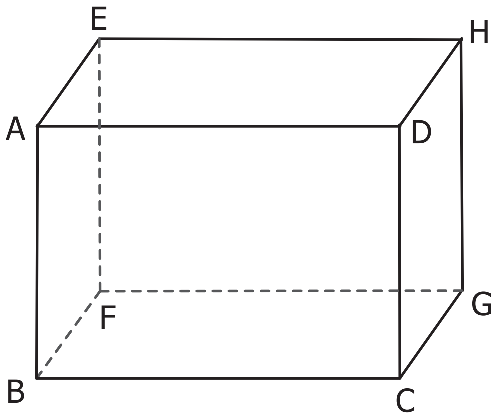
(i)



(ii)

(iii)

2. Find the parallel and intersecting line segments in the picture given below.



3. Name the following angles as shown in the figure.

   (i) ∠1 =

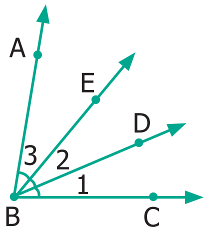
   (ii) ∠2 =

   (iii) ∠3 =

   (iv) ∠1 + ∠2 =

   (v) ∠2 + ∠3 =

   (vi) ∠1 + ∠2 + ∠3 =



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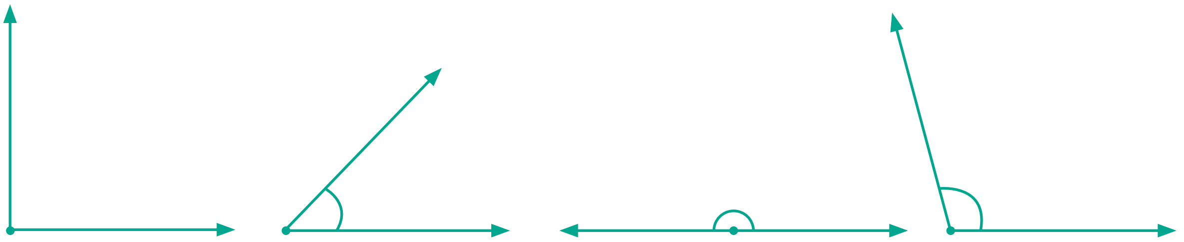
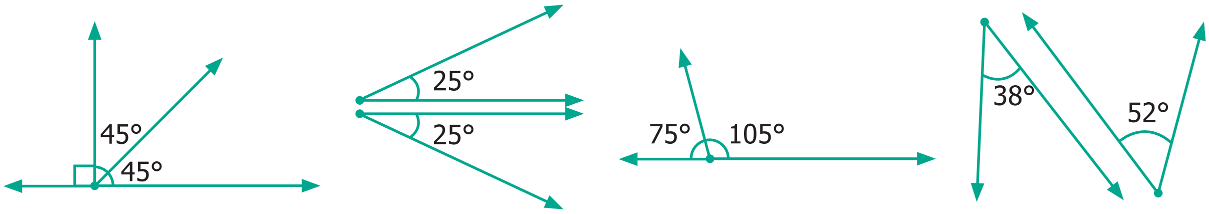
4. Measure the angles of the given figures using protractor and identify the type of angle as acute, obtuse, right or straight.



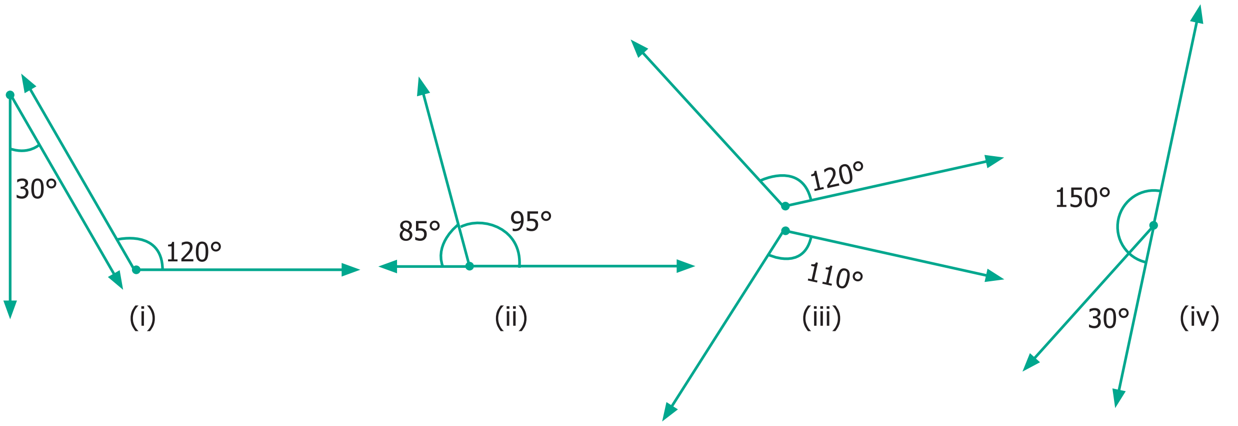
(i) (ii) (iii) (iv)

5. From the figures given below, classify the following pairs of angles into complementary and non complementary.



(i) (ii) (iii) (iv)

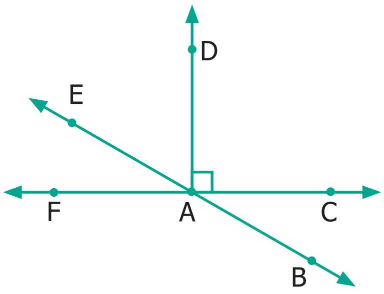
6. From the figures given below, classify the following pairs of angles into supplementary and non supplementary.



7. From the figure

(i) name a pair of complementary angles

(ii) name a pair of supplementary angles



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Challenging Problems

8. Think and write an object having
   - Parallel lines (1) __________ (2) __________ (3) __________
   - Perpendicular lines (1) __________ (2) __________ (3) __________
   - Intersecting lines (1) __________ (2) __________ (3) __________
9. Which angle is equal to twice its complement?
10. Which angle is equal to two-third of its supplement?
11. Given two angles are supplementary and one angle is 20° more than other. Find the two angles.
12. Two complementary angles are in ratio 7:2. Find the angles.
13. Two supplementary angles are in ratio 5:4. Find the angles.

Summary

- A line extends along both directions without end.
- A line segment has two end points.
- Parallel lines never meet.
- When two lines meet they are called intersecting lines.
- When two rays have common starting point, they form an angle at that point.
- We measure angles using protractor.
- An angle whose measure is less than 90° is called an acute angle.
- An angle whose measure is exactly 90° is called a right angle.
- An angle whose measure is greater than 90° is called an obtuse angle.
- When the two rays or lines coincide, they are said to make angle zero, that is 0°.
- Two angles are complementary when they add up to 90°.
- Two angles are supplementary when they add up to 180°.
- Given any two points there is a unique line passing through them.
- When three points lie on a line, they are said to be collinear.
- When two lines meet each other at 90° at the point of intersection, they are called perpendicular lines.
- When three or more lines pass through the same point, they are said to be concurrent. That point is called the Point of Concurrency.

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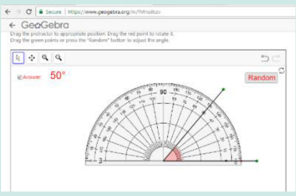
ICT Corner

GEOMETRY

Expected Result is shown in this picture



Step – 1

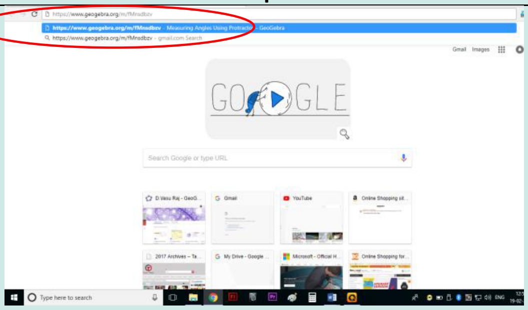
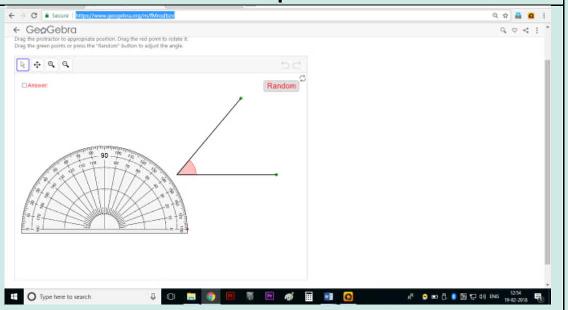
Open the Browser, copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

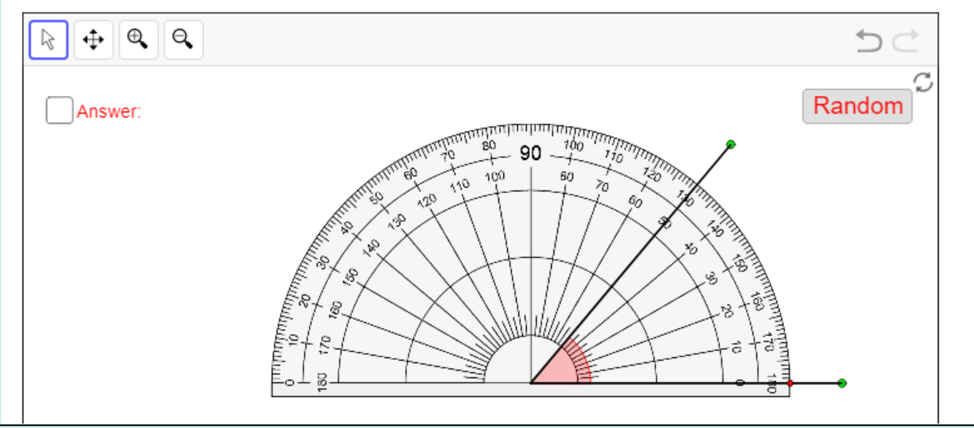
GeoGebra Work Book called "Measuring Angles Using Protractor" will appear. An angle and a Protractor will appear.

Step-3

Drag the protractor and place it on the angle and measure it. Now Click on the "**Answer**" Box to check whether your measurement is correct. Click on "**Random**" button to create new angle and continue till you understand how to measure the angle.

.Step-1	Step-2
	

Step-3



Browse in the link

Measuring Angles: https://www.geogebra.org/m/fMnsdbzv

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Chapter 5

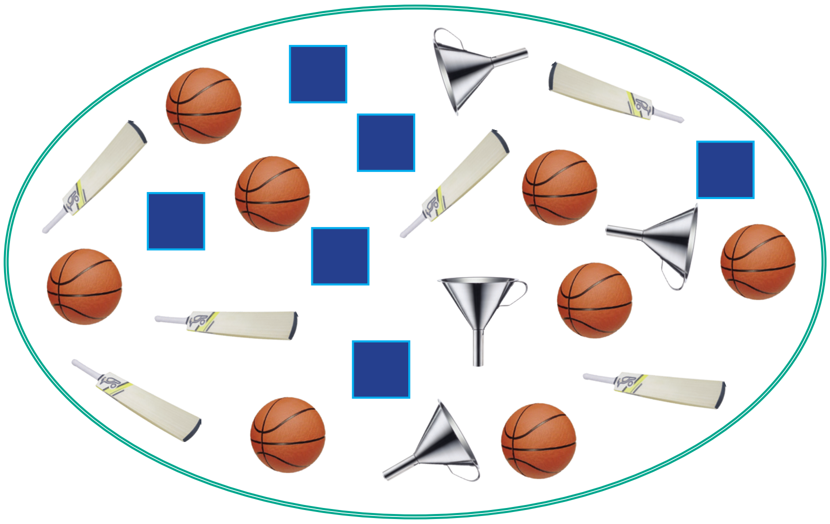
STATISTICS

Learning Objectives

- To understand the necessity of collecting data.
- To organise collected data using tally marks.
- To understand the need for scaling in pictographs.
- To draw pictographs and interpret them.
- To draw bar graphs and interpret them.

Recap

Count the objects in the following figure and complete the table that follows:



Object	Number of Objects
Ball	8
Bat	
Funnel	
Square	

From the given Figure and the table, answer the following questions.

(i) The total number of objects in the above picture is __________.

(ii) The difference between the number of squares and the number of bats is __________.

(iii) The ratio of the number of balls to the number of bats is __________.

(iv) What are the objects equal in number?

(v) How many more balls are there than the number of bats?

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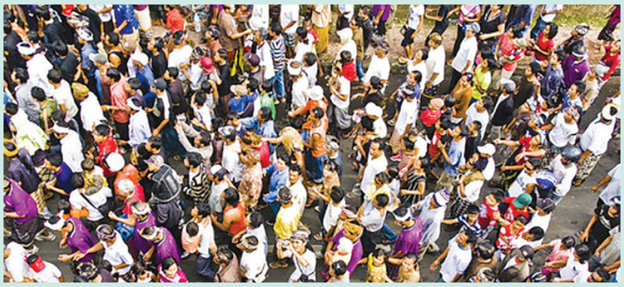
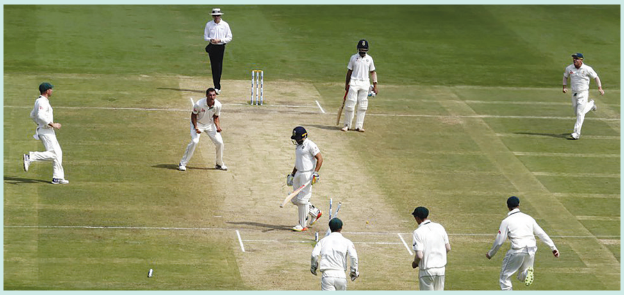
5.1 Introduction

Fig.5.1

Think about this situation

The Headmaster of a school (see Fig. 5.1) wanted to open Saving Bank accounts for his students. For this, he needed data from his students. Students did not understand the meaning of the word 'data'. Do you know what it means? Data means, "collection of information about anything". Data is collected, measured and analyzed, whereupon it can be visualized using graphs or images. In this case, the details could consist of information like the ration card number with address, the name of the student, Aadhaar card identity number, date of birth, phone number for communication etc., These are preserved for drawing inferences.

Name of the student	Aadhaar Number	Date of birth	Phone Number
D. Nallathambi	....	....	....

MATHEMATICS ALIVE – STATISTICS IN REAL LIFE	
	
Population census	Wickets taken by the bowler in last 5 matches

5.2 Data

In our daily life, we come across many situations where we need to collect information in the form of Facts or Numbers.

For example,

- Number of students using calculators in your class.
- Number of brothers and sisters in your family.

DO YOU KNOW?

The word 'data' was first used in 1640's.In 1946, the word 'data' also meant for "transmittable and storable computer information". In 1954, a term called 'data processing' was introduced. The plural form of 'datum' is 'data'. It also means "given" or "to give" in Latin.

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- Number of different types of houses in a village.
- Number of girls wearing bangles.
- Number of buses crossing a certain road junction at a particular time.
- Number of persons in a street who watch T.V. for more than 2 hours a day.
- Number of shops in a shopping mall selling textiles.
- Speeds of bikes, cars and other vehicles passed along a specific highway.

Thus, the numerical information or facts collected are known as Data.

5.2.1 Collection of data

Santhi collected the following information about her friend's preference of sweets which is as shown below.

Friend's name	Sweet preferred	Friend's name	Sweet preferred
Vetri	Gulabjamun	Sadaiyan	Laddu
Kurinji	Laddu	Rafiq	Gulabjamun
Mullai	Cake	Francis	Laddu
Madhavi	Gulabjamun	Vetriselvi	Laddu
Pegan	Cake	Mary	Gulabjamun
Rahim	Laddu	Fathima	Laddu
Nawaz	Cake	Raju	Cake
Siva	Gulabjamun	Robert	Gulabjamun
Joseph	Laddu	Kalai	Cake
Tamil	Gulabjamun	Anbu	Kesari
Malar	Laddu	Thamarai	Gulabjamun
Velan	Kesari	Mariya	Laddu
Malarkodi	Cake	Manimozhi	Kesari
Selvi	Gulabjamun	Mubina	Gulabjamun
Arivu	Laddu	Kottravai	Gulabjamun

This way of collecting the data helps Santhi to decide, what sweets to get for her birthday and how much for each.

TRY THESE

- Tabulate different kinds of crops cultivated by the farmers in a village
- List out different kinds of plants/trees in your school campus

ACTIVITY

Collect the data of the birth months of your classmates.

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5.2.2 Types of Data

On the basis of collection, data are of two types. They are primary data and secondary data.

Primary data

Primary data means the raw data (not tailored data) which has just been collected from the original source and has not gone any kind of statistical treatment like sorting and tabulation.

ACTIVITY

Collect data on the level of literacy of people in your street.

Examples

- List of absentees in the class.
- A survey on writing habits of students conducted by a pen manufacturing company.
- The types of leaves collected by students for studying nature.

Secondary Data

Secondary data consists of second hand information which has already been collected. It could have been collected by someone other than the user, for some other purpose.

Examples

- The Headmaster collects the students' absentee list from school office.
- Cricket scores gathered from a website.
- Data from Television and Newspapers.
- List of contact numbers from telephone directory.

DO YOU KNOW?

Primary data is collected in person and so more reliable than Secondary data.

5.2.3 Organizing Data

The collected data are to be arranged methodically or logically so that the information can be looked up fast whenever needed, easily and efficiently. The method of organizing the data is discussed as follows.

Tally Marks

Consider the data collected by Santhi (given in Table). Is it easy to get the required information from the data? For example, can any one quickly tell the number of people who do not like Laddu? No. So she decides to organize the data (See Fig. 5.2).

Fig.5.2

Her friends come to help her. Malar arranges the data as given below in the table. She uses '✓' marks to note down how many friends like each of the sweets. The count of each sweet is called as "Frequency".

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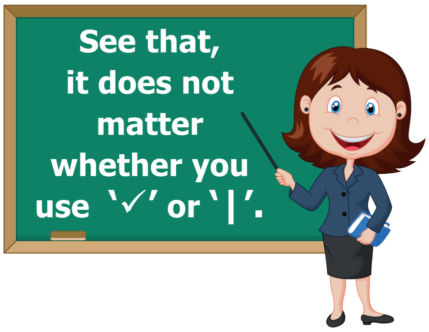
Sweet	Marks	Frequency
Kesari	✓✓✓	3
Gulabjamun	✓✓✓✓✓✓✓✓✓✓✓	11
Laddu	✓✓✓✓✓✓✓✓✓✓	10
Cake	✓✓✓✓✓✓	6

But, Rahim arranges the data as shown below.

Sweet	Tally Marks	Frequency
Kesari	|||	3
Gulabjamun	|||||||||||	11
Laddu	||||||||||	10
Cake	||||||	6



Both have done well. But one would prefer tally marks as they are very simple.

One	Two	Three	Four	Five
|	||	|||	||||	𝍸

As in the above table, the teacher arranges the data as follows:

Sweet	Tally Marks	Frequency
Kesari	|||	3
Gulabjamun	𝍸 𝍸 |	11
Laddu	𝍸 𝍸	10
Cake	𝍸 |	6

The standard form of representing the data is obtained by using 'Tally marks'.

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NOTE

- The occurrence of each information is marked by a vertical line '|'.
- Every fifth tally is recorded by striking through the previous four vertical lines as '𝍸'.
- This makes counting up the tallies easy.

Example 5.1

Thamarai is fond of reading books. The number of pages read by her on each day during the last 40 days are given below. Make a Tally Marks table.

1 3 5 6 6 3 5 4 1 6 2 5 3 4 1 6 6 5 5 1

1 2 3 2 5 2 4 1 6 2 5 5 6 5 5 3 5 2 5 1

Solution

The Tally marks table is given below.

Number of pages	Tally Marks	Frequency
1	𝍸 ||	7
2	𝍸 |	6
3	𝍸	5
4	|||	3
5	𝍸 𝍸 ||	12
6	𝍸 ||	7
Total		40

THINK

If someone asks, "typically, how many pages does Thamarai read in one day?", what will be your answer?

Exercise 5.1

1. Fill in the blanks.

   (i) The collected information is called ___________.

   (ii) An example of a Primary Data is ___________.

   (iii) An example of a Secondary Data is ___________.

   (iv) The tally marks for number 8 in standard form is ___________.

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2. Viji threw a die 30 times and noted down the result each time as follows. Prepare a table on the numbers shown using Tally Marks.

1	4	3	5	5	6	6	4	3	5	4	5	6	5	2
4	2	6	5	5	6	6	4	5	6	6	5	4	1	1

3. The following list tells colours liked by 25 students. Prepare a table using Tally Marks.

Red	Blue	White	Grey	White
Green	Grey	Blue	Green	Grey
Blue	Grey	Red	Green	Red
Blue	Blue	Green	Blue	Green
Grey	Grey	Green	Grey	Red

4. The following are the marks obtained by 30 students in a class test out of 20 in Mathematics subject.

11	12	13	12	12	15	16	17	18	12
20	13	13	14	14	14	15	15	15	15
16	16	16	15	14	13	12	11	19	17

Prepare a table using Tally Marks.

5. The table shows the number of calls recorded by a Fire Service Station in one year.

Types of Calls	Tally Marks	Frequency
Building Fires	𝍸 |	
Other Fires	𝍸 𝍸 |	
Hazardous Materials		7
Rescues		4
False Alarms	𝍸 ||	
Total		

Complete the table and answer the following questions.

(i) Which type of call was recorded the most?

(ii) Which type of call was recorded the least?

(iii) How many calls were recorded in all?

(iv) How many calls were recorded as False Alarms?

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Objective Type Questions

6. The tally marks for the number 7 in standard form is __________.

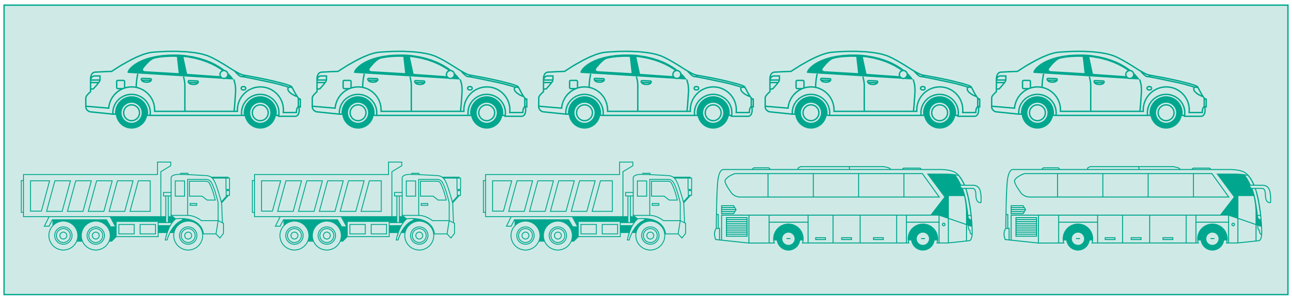
   (a) 7 (b) 卌 || (c) ✓✓✓✓✓✓✓ (d) |||||||

7. The tally marks 卌 |||| represents the number count

   (a) 5 (b) 8 (c) 9 (d) 10

5.3 Representation of data using Pictograph

The teacher was discussing about the pollution caused by the vehicles. The students said that they saw many vehicles when they were standing in the bus stop while coming to school. Everyone described in their own way, but Azhagi drew the pictures of the vehicles that she had seen, as shown below.



All the students were able to easily understand that Azhagi had seen 5 cars, 3 lorries and 2 buses. This sort of representation of data using pictures is called Pictograph.

Nowadays pictographs are frequently used in promotion of tourism, weather forecast, geography etc.

Advantages of using Pictograph

- The data can be easily analyzed and interpreted.
- The pictures and symbols help us to understand better.

NOTE

A pictograph is the representation of data through pictures.

DO YOU KNOW?

- The pictograph is a pictorial representation for a word or Phrase.
- A pictograph is also called Pictogram.
- Pictographs were used as the earliest known form of writing examples having been discovered in Egypt and Mesopotomia since 3000 BC.

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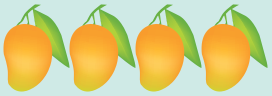
5.3.1 Need for scaling in the Pictograph

Fig. 5.3 shows, a fruit stall where there are 40 mangoes, 55 apples, 35 oranges and 60 bananas. How can we represent this data by using pictures? If the data is very large, it is very difficult and time consuming to represent each of the fruits in a pictograph. In such cases, we can use one picture to represent many of the same kind. This is called scaling.

Fig. 5.3

5.3.2 Drawing Pictographs

Consider the above data of fruits. 40 and 60 are multiples of 10, while 55 and 35 are multiples of 5. Let us assume, that One full picture of fruit represents 10 fruits and One half picture represents 5 fruits.

Name of the fruits	Number of fruits
Mangoes	
Apples	
Bananas	
Oranges	

The pictograph can be drawn for the above data as shown in the table.

5.3.3 Interpreting pictograph

From the above pictograph the number of fruits can be calculated very easily.

Number of Mangoes = 4 full pictures $\Rightarrow 4 \times 10 = 40$ mangoes

Number of Apples = 5 full pictures and 1 half picture
$\Rightarrow (5 \times 10) + 5 = 55$ apples

Number of Bananas = 6 full pictures $\Rightarrow 6 \times 10 = 60$ bananas

Number of Oranges = 3 full pictures and 1 half picture
$\Rightarrow (3 \times 10) + 5 = 35$ oranges

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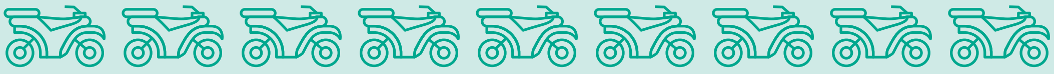
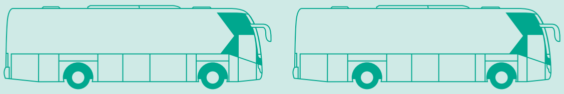
Example 5.2

The following table shows the number of vehicles sold in a year.

Car	
Van	
Motor Cycle	
Bus	
Bicycle	

Key: One picture represents 10 vehicles

Look at the pictograph and answer the following questions.

(i) How many motor cycles were sold in a year?

(ii) Number of buses sold in a year is 20. Say True or False.

(iii) How many bicycles were sold ?

(iv) How many cars and vans were sold?

(v) How many vehicles were sold altogether?

Solution

Given : 1 picture represents 10 vehicles

(i) There were $9 \times 10 = 90$ motor cycles sold.

(ii) True.

(iii) There were $4 \times 10 = 40$ bicycles sold.

(iv) There were 7 cars and 3 vans pictures.
Therefore $70 + 30 = 100$ cars and vans sold.

Activity

Collect from class VI students data regarding games they like and then draw a pictograph for the data collected.

(v) There were 7 cars, 3 vans, 9 motor cycles, 2 buses and 4 bicycles sold.
Therefore, $70 + 30 + 90 + 20 + 40 = 250$ vehicles sold.

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Exercise 5.2

1. Fill in the blanks.

   (i) If represents 100 balls then represents __________ balls.

   (ii) If 200 is represented by then 600 is represented by __________.

   (iii) Representation of data by using pictures is known as __________.

2. Draw a pictograph for the given data.

Month	June	July	August	September
Number of Computers sold	300	450	600	550

(Choose your own suitable scale)

3. The following table shows the number of tourists who visited the places in the month of May. Draw a pictograph.

Place	Mahabalipuram	Vedanthangal	Hogenakkal	Ooty
Number of Tourists	20,000	15,000	40,000	35,000

(Choose your own suitable scale)

4. The following Pictograph shows the number of students playing different games in a school.

Game	Number of Students
Kho-Kho	
Kabaddi	
Basketball	
Volleyball	
Hockey	

Represents 10 students

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Answer the following questions.

(i) Which is the most popular game among the students?

(ii) Find the number of students playing Kabaddi.

(iii) Which two games are played by equal number of students?

(iv) What is the difference between the number of students playing Kho-Kho and Hockey?

(v) Which is the least popular game among the students?

Objective Type Questions

5. The representation of 'one picture to many objects' in a Pictograph is called ________.

   (a) Tally mark (b) Pictoword (c) Scaling (d) Frequency

6. A Pictograph is also known as ___________.

   (a) Pictoword (b) Pictogram (c) Pictophrase (d) Pictograft

5.4 Representation of data using Bar Graph

Ragavi's father is a mobile shop owner. She finds the following data of sale of mobiles in a week.

Day	Number of Mobiles Sold
Sunday	50
Monday	45
Tuesday	40
Wednesday	20
Thursday	35
Friday	30
Saturday	55

What if the number of mobiles be 4, 37 or 305? How many pictures will be used?

Yes! Try this!

For this data instead of pictographs, something different can be used.

NOTE

A Bar graph consists of equally - spaced parallel bars (Horizontal or Vertical) whose lengths / heights are proportional to the number of items given.

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5.4.1 Drawing Bar-Graph

Step 1: Draw two lines which are perpendicular to each other. One of them is horizontal and the other one is vertical.

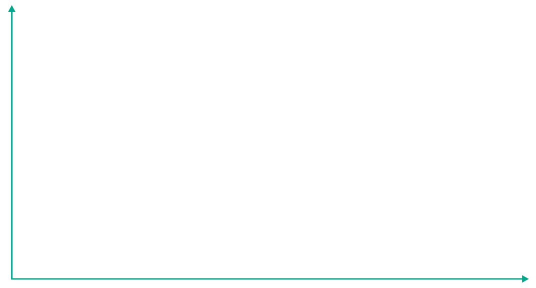

Fig. 5.5

Step 2: A suitable title (Sale of mobiles in a week) is given. The lines are labelled (Horizontal line ⟶ Days of the week; vertical line ⟶ Number of mobiles sold).

Fig. 5.6

Step 3: A suitable scale is chosen. The scale used is stated on the graph.

Fig. 5.7

Step 4: Let the vertical line start from 0 and the values of information are marked at equal distances in same increments.

Fig. 5.8

Step 5: For each information vertical bars are drawn on the horizontal line. They are labelled by respective information (as Monday, Tuesday… Sunday).

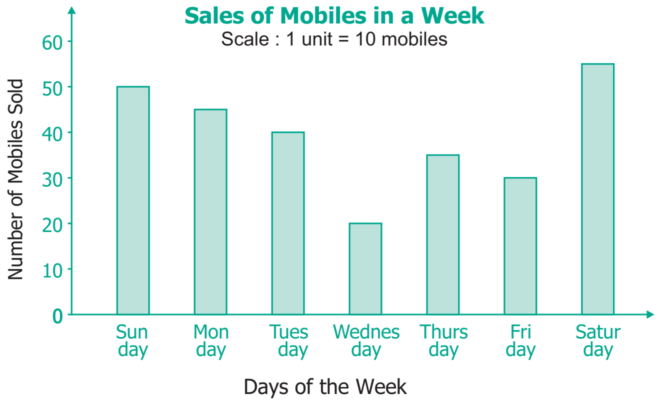

Fig. 5.9

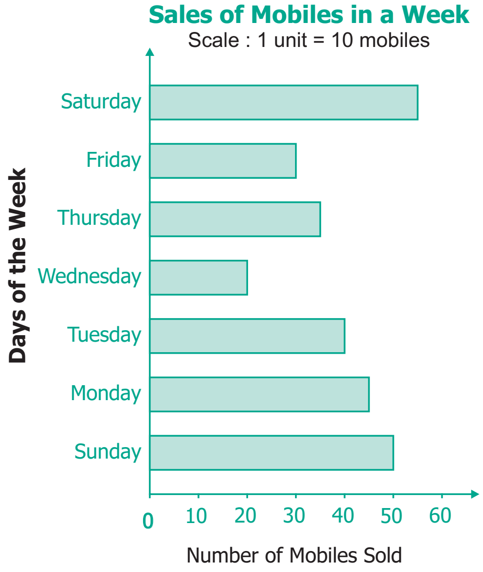

Fig. 5.10

This graph is called as Vertical Bar Graph.

The corresponding horizontal Bar Graph will look like this:

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5.4.2 Interpreting the Bar Graph

The data from the above Bar Graph (Fig. 5.10) can be easily interpreted and analyzed as follows.

- The maximum number of mobiles were sold on Saturday (55).
- The minimum number of mobiles were sold on Wednesday (20).
- The total number of mobiles sold in the week (50+45+40+20+35+30+55 = 275).
- The number of mobiles sold on a particular day (for example: on Friday is 30, etc.,).

ACTIVITY

Collect different data from Newspapers, Magazines, etc. and interpret them using Bar graphs.

Example 5.3

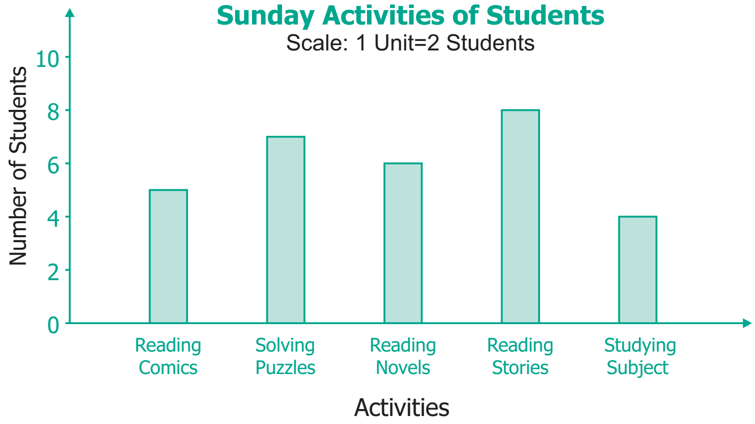

Fig. 5.11

THINK

Why are these important?

- The width of each bar is same.
- The spaces between any two bars are also the same.

Study the above Bar graph and answer the following questions.

(i) Which activity is followed by maximum number of students?

(ii) How many students in all, spend their time on solving puzzles?

(iii) The total number of students who follow either reading stories or reading their subjects is ___________.

(iv) The activity followed by minimum number of students is ___________.

(v) The number of students who took part in reading comics is ___________.

Solution

(i) 'Reading stories' is followed by maximum number of students.

(ii) 7 students spend their time to work out solving puzzles.

(iii) 8 + 4 = 12 students spend their time on reading stories or subjects.

(iv) 'Studying subject' is followed by minimum number of students.

(v) 5 students spend their time on reading comics.

THINK

Can you use 1 unit =1 student? Justify your answer.

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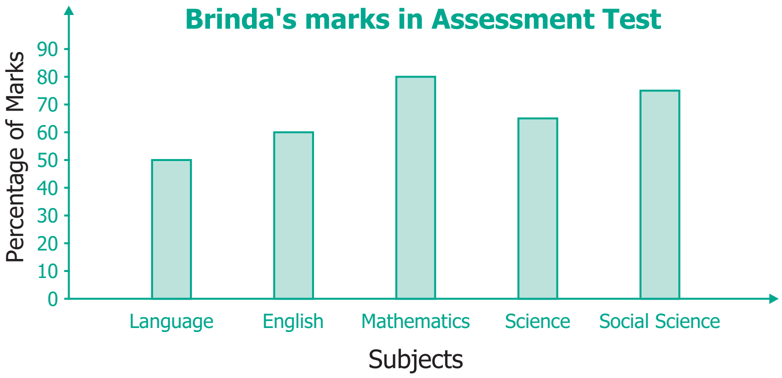
Exercise 5.3

1. Read the given Bar Graph which shows the percentage of marks obtained by Brinda in different subjects in an assessment test.



Observe the Bar Graph and answer the following questions.

(i) 1 Unit = __________ % of marks on vertical line.

(ii) Brinda has scored maximum marks in __________ subject.

(iii) Brinda has scored minimum marks in __________ subject.

(iv) The percentage of marks scored by Brinda in Science is __________.

(v) Brinda scored 60% marks in the subject __________.

(vi) Brinda scored 20% more in __________ subject than __________ subject.

2. Chitra has to buy Laddus in order to distribute to her friends as follows:

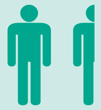
Classes	VI	VII	VIII	IX	X
Number of Laddus	70	60	45	80	55

Draw a Bar Graph for this data.

3. The fruits liked by the students of a class are as follows. Draw a Bar Graph for this data.

Fruits	Bananas	Grapes	Apples	Mangoes	Guavas	Papayas	Other fruits
Number of students	8	10	8	7	12	3	2

4. The pictograph below gives the number of absentees on different days of the week in class six. Draw the Bar graph for the same.

Day	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Number of Absentees					--	

represents 4 students represents 2 students

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Objective Type Questions

5. A bar graph can be drawn using __________.

   (a) Horizontal bars only

   (b) Vertical bars only

   (c) Both horizontal bars and vertical bars

   (d) Either horizontal bars or vertical bars.

6. The spaces between any two bars in a bar graph __________.

   (a) can be different (b) are the same

   (c) are not the same (d) all of these

Exercise 5.4

Miscellaneous Practice Problems

1. The heights (in centimeters) of 40 children are.

110	112	112	116	119	111	113	115	118	120
110	113	114	111	114	113	110	120	118	115
112	110	116	111	115	120	113	111	113	120
115	111	116	112	110	111	120	111	120	111

Prepare a tally marks table.

2. The following pictograph shows the total savings of a group of friends in a year. Each picture represents a saving of Rs.100. Answer the following questions.

Ruby	
Malarkodi	
Thasnim	
Kuzhali	
Iniya	

represents Rs.100

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(i) What is the ratio of Ruby's saving to that of Thasnim's?

(ii) What is the ratio of Kuzhali's savings to that of others?

(iii) How much is Iniya's savings?

(iv) Find the total amount of savings of all the friends?

(v) Ruby and Kuzhali save the same amount. Say True or False.

3. There are 1000 students in a school. Data regarding the mode of transport of the students is given below. Draw a pictograph to represent the data.

Mode of Travel	On Foot	Bicycle	Scooter	Bus	Car
Number of Students	350	300	150	100	100

Challenging Problems

4. The prediction of Weather in the month of September is given below.

September						
Sunday	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**
					1 [Sunny]	2 [Cloudy]
3 [Cloudy]	4 [Sunny]	5 [Partly Cloudy]	6 [Cloudy]	7 [Rainy]	8 [Sunny]	9 [Sunny]
10 [Partly Cloudy]	11 [Cloudy]	12 [Partly Cloudy]	13 [Sunny]	14 [Cloudy]	15 [Rainy]	16 [Rainy]
17 [Rainy]	18 [Sunny]	19 [Sunny]	20 [Sunny]	21 [Partly Cloudy]	22 [Partly Cloudy]	23 [Cloudy]
24 [Sunny]	25 [Cloudy]	26 [Cloudy]	27 [Partly Cloudy]	28 [Rainy]	29 [Sunny]	30 [Rainy]

Sunny Partly Cloudy Cloudy Rainy

(i) Make a frequency table of the types of weather by reading the calendar.

(ii) How many days are either cloudy or partly cloudy?

(iii) How many days do not have rain? Give two ways to find the answer?

(iv) Find the ratio of the number of Sunny days to Rainy days.

5. The table shows the number of moons that orbit each of the planets in our solar system.

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Number of Moons	0	0	1	2	28	30	21	8

Make a Bar graph for the above data.

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6. 26 students were interviewed to find out what they want to become in future. Their responses are given in the following table.

Profession	Tally marks
Teacher	卌 II
Pilot	III
Bank Manager	卌
Doctor	III
Engineer	卌
Other Professions	III

Represent this data using Pictograph.

7. Yasmin of class VI was given a task to count the number of books which are biographies, in her school library. The information collected by her is represented as follows.

Biographies	Number of books
Mathematicians	
Scientists	
Novelists	
Sportspersons	
Politicians	

Key:

represents 20 books

Observe the pictograph and answer the following questions.

(i) Which title has the maximum number of biographies?

(ii) Which title has the minimum number of biographies?

(iii) Which title has exactly half the number of biographies as Novelists?

(iv) How many biographies are there on the title of Sportspersons?

(v) What is the total number of biographies in the library?

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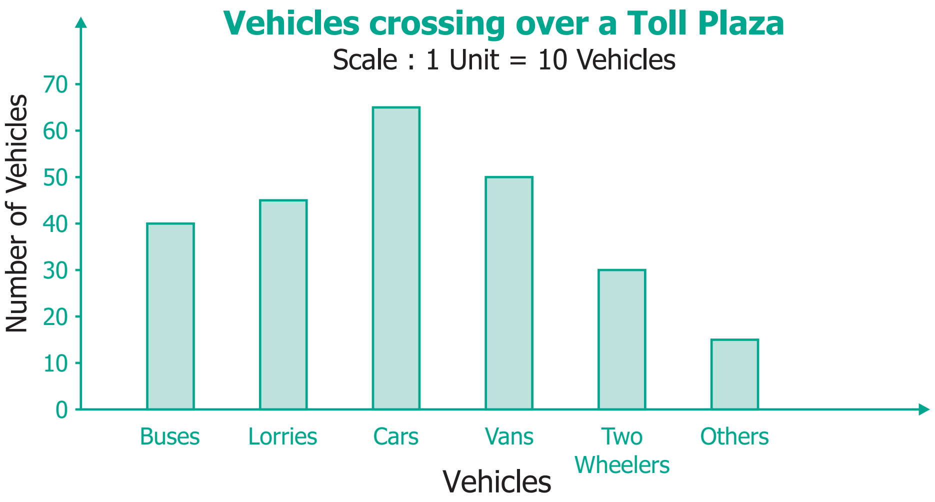
8. The bar graph illustrates the results of a survey conducted on vehicles crossing over a Toll Plaza in one hour.



Observe the bar graph carefully and fill up the following table.

Vehicles	Buses	____	Cars	Vans	____	Others	Total vehicles
Number of Vehicles	____	45	____	____	30	____	____

9. The lengths (in the nearest centimetre) of 30 drumsticks are given as follows.

Lengths	Number of drumsticks
24	卌
25	--
26	--
27	卌 |
28	--
29	卌 |||
30	卌 |
31	卌

Draw the bar graph showing the same information.

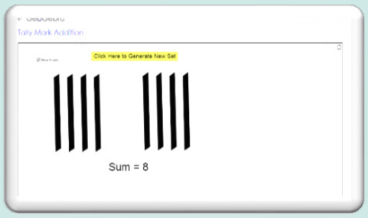
Summary

- Information collected is known as data.
- First-hand information is called primary data.
- The data collected by someone else is called secondary data.
- The data collected is organized usually in a tally marks table.
- The organized data can be represented using a pictograph or a bar graph.
- A pictograph is the representation of data through pictures of objects.
- A bar graph consists of parallel bars (horizontal or vertical) whose length corresponds to the number of items.

ICT Corner

STATISTICS

Expected Result is shown in this picture →



Step – 1

Open the Browser, Copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

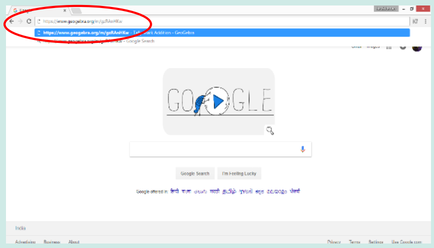
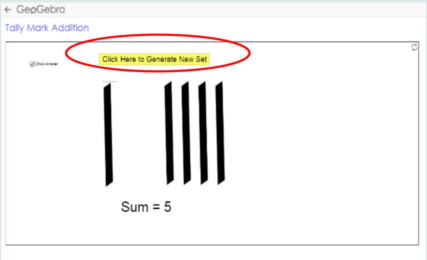
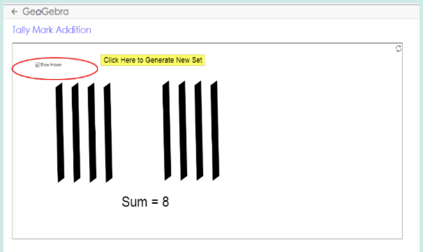
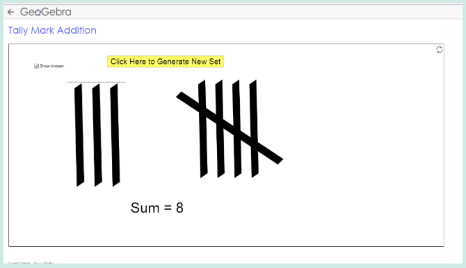
GeoGebra worksheet "Tally Mark Addition" will appear. You can generate a new set by clicking "Click here to generate a new set".

Step-3

Select "Show Answer" check box to view the answers for the sets.

Step 4:

Generate various results and observe the difference in set formation

Step-1	Step-2
	
Step-3	**Step-4**
	

Geogebra's url :

https://www.geogebra.org/m/gzRAnHKw

Alternate source to try tally calculations:

https://play.google.com/store/apps/details?id=org.geogebra&hl=en

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Chapter 6

INFORMATION PROCESSING

Learning Objectives

- To learn about systematic listing and counting.
- To solve puzzles like Sudoku and triangles by systematics completion.

6.1 Introduction

Ponmozhi is at her cousin's wedding which has a large gathering of people. There are a few hundred people, for sure. Suddenly her uncle comes and says, "We are getting ready to serve the meal; one of you quickly count the number of people and tell me". "Ponmozhi, you are good at counting; Do this quickly and tell to me, I will be inside, getting the plantain leaves ready."

It will be very tedious to count each and everyone assembled there. Ponmozhi is standing on a chair and is trying to count everyone. Suddenly, Ponmozhi is unsure of the count that she made and she did not want to count the same head more than once.

Ponmozhi was told that the task of counting was not easy. While counting, some people may leave, some may enter and some may move here and there. So it is difficult to make sure that her count would be correct.

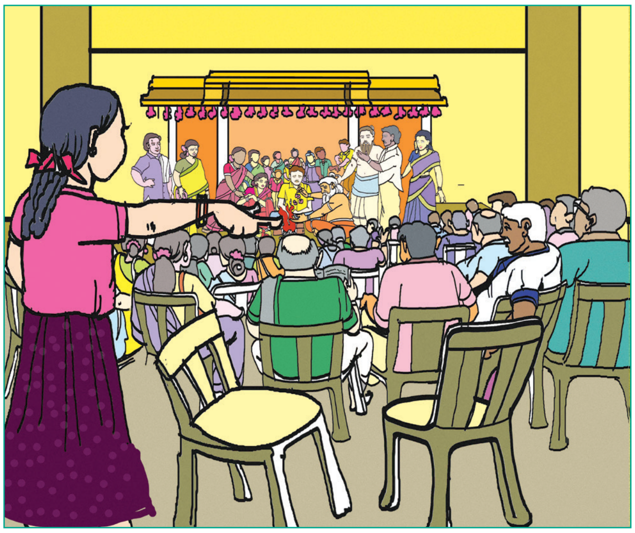

Fig. 6.1

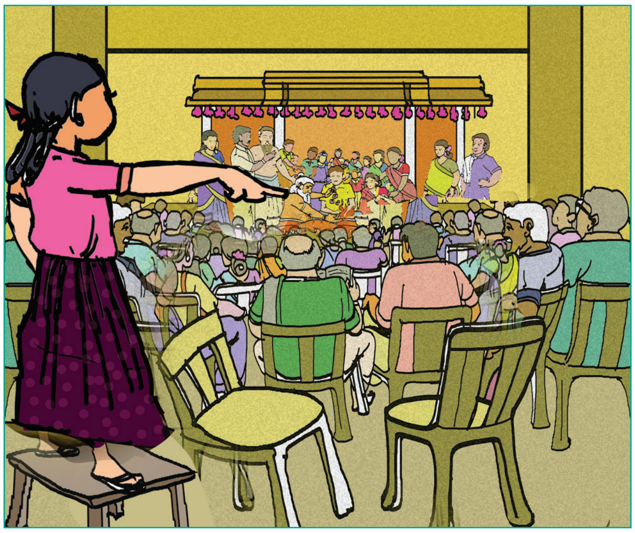

Fig. 6.2

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But in a wedding feast it does not matter if there is a small error in the count: Whether there are 384 persons or 417 persons in the hall it does not really make much of a difference. Food made ready for 400 persons can be sufficient for 20 more persons. Mathematics will help not only in exact counting but also in estimation and approximate counting, depending on what is actually needed.

Instead of the above wedding hall situation, counting the number of children in the classroom is very easy. But counting the number of people in the wedding hall is difficult. There are many reasons for this.

The number of children in the classroom is small, in 10s rather than 100s. Children sit in the benches, the same number on each bench and the benches are organized in rows and columns. Children sit in one place when you are counting. The number is too small to ask the children to count starting from the left of the first row to the right of the last row, as the children themselves have collectively counted the number present in the class. But again we need not do this. If 3 children sit on each bench and there are 3 benches in a row and there are 4 rows, and every bench in the class is fully occupied, then we have $3 \times 3 \times 4 = 36$ children in class. But what should we do if all benches are not occupied full? If there are 3 benches with only 2 children and one bench with only one child, we only need to subtract (3+2) from 36 to get 31 children in the class. Importantly, not only we can get the answer, but also we can be confident that everyone was counted, and that nobody was left uncounted or counted twice.

The absence of these factors makes counting in wedding halls more difficult. In general, we can say:

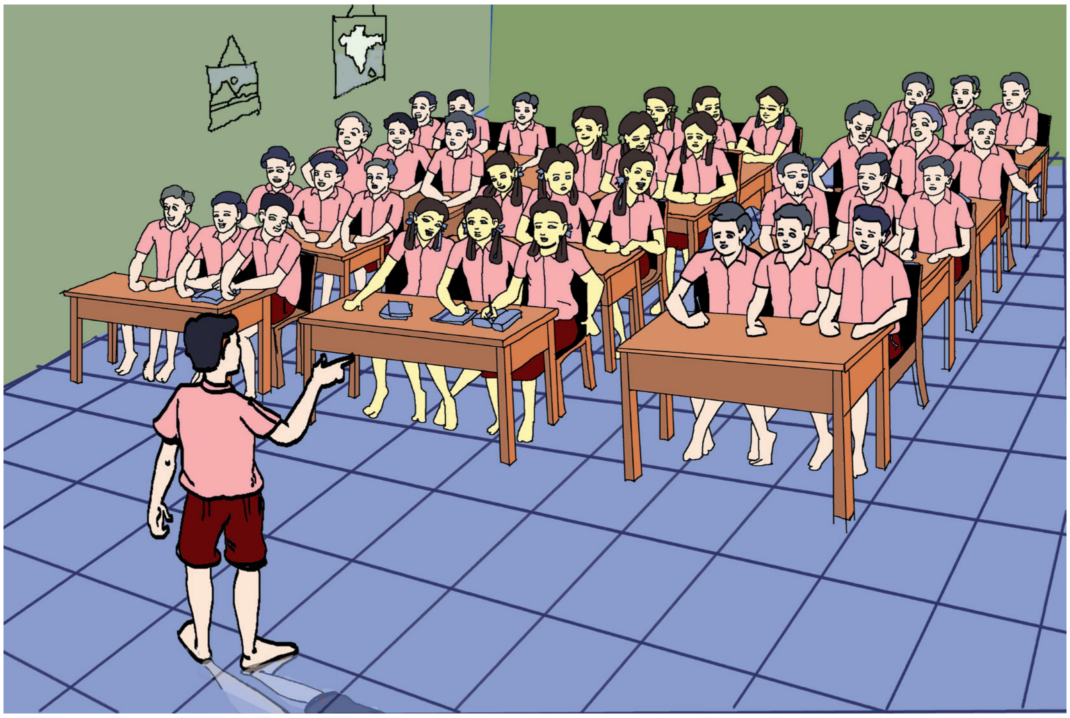

Fig. 6.3

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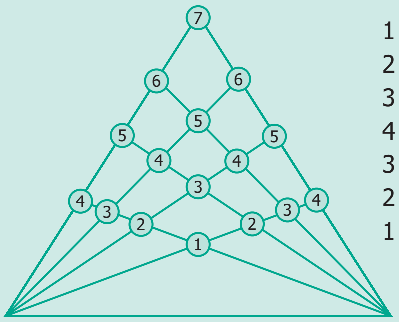
The place in which the things are counted is fixed and arranged in some order, then counting is easy, otherwise it is difficult.

This suggests that the things should be in order if it is needed to be counted easily.

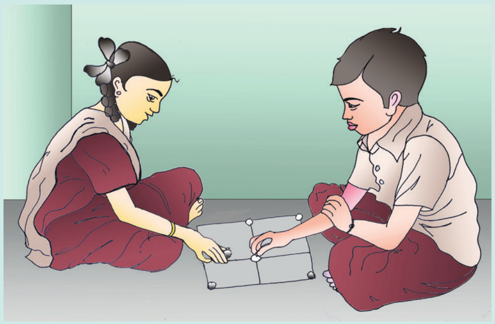
MATHEMATICS ALIVE - INFORMATION PROCESSING IN REAL LIFE



$1 \times 1 = 1$
$2 \times 2 = 4$
$3 \times 3 = 9$
$4 \times 4 = 16$
$3 \times 5 = 15$
$2 \times 6 = 12$
$1 \times 7 = 7$
64

Systematic sorting of triangles

Fig.6.4



Logical reasoning in 3 kal-aattam

Fig.6.5

6.2 Systematic listing

There are two shorts and three shirts. In how many different combinations can you wear them?

At a time you are going to pick one of the shorts and different shirts. We denote the shorts as A and B, and the shirts as p, q and r. Then you can wear one of these: A p, A q, A r, B p, B q and B r.

Thus you have six different combinations and you know that you have counted all the possibilities. This is systematic listing.

Situation 1

Your friend has built a house with three floors. He wants to paint each floor with three different colours red, blue and green. Can you help him to find different ways of possible colour combinations to paint the home?

Fig.6.6

In how many ways can his house be painted with these three colours?

Let us consider the floors as the Third floor, the Second floor and the First floor. We can say that

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the painting can be done as RBG, BRG, GRB…etc. But here it is possible that we may miss out some patterns of colours. So, we can use systematic listing as given below.

Step 1: Fix one colour; try the possible arrangements with other colours. For example, if the Third floor is fixed as Red, then we get 2 ways which is shown in the table below.

Fix Third floor Colour	Second floor Colour	First floor Colour
Red	Blue	Green
Red	Green	Blue

Step 2: If the Third floor is fixed as Blue, then we get another 2 ways which is shown in the table below.

Fix Third floor Colour	Second floor Colour	First floor Colour
Blue	Green	Red
Blue	Red	Green

Step 3: If the Third floor is fixed as Green, then we get 2 more ways which is shown in the table below.

Fix Third floor Colour	Second floor Colour	First floor Colour
Green	Blue	Red
Green	Red	Blue

Hence, we get 6 different ways of painting the three floors, which are R-B-G, R-G-B, B-G-R, B-R-G, G-B-R and G-R-B.

Situation 2

Suppose you want to write four digit numbers by using the digits 3, 6, 9 and 5. What are the possible numbers you can write using each digit exactly once?
If you list randomly, for example 9365, 3695, 5639 and so on, you may not write all the possibilities. So, write in ascending order.

- All numbers beginning with 3:

Fix next digit and change the other 2 digits. We get, 3569, 3596, 3659, 3695, 3956, 3965.
Similarly,

- All numbers beginning with 5 : 5369, 5396, 5639, 5693, 5936, 5963
- All numbers beginning with 6 : 6359, 6395, 6539, 6593, 6935, 6953
- All numbers beginning with 9 : 9356, 9365, 9536, 9563, 9635, 9653
  Totally, we can have 6+6+6+6 = 24 numbers

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TRY THESE

Mother had a lot of wooden pieces in different shapes with her. She gave 6 triangles to Kannagi and 6 circles to Madhan and asked them to create different figures using them. They tried and got some interesting figures. Can you create figures like them that are nice and interesting?

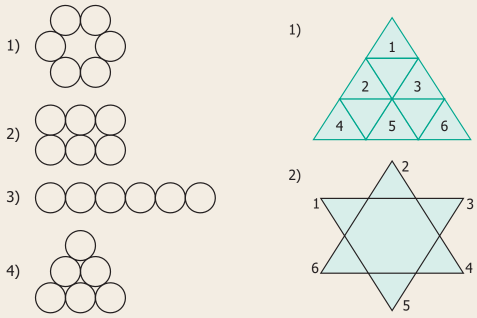

Fig.6.7

Space for new figures

6.3 Systematic completion of lists

Suppose that you are already given a list that is partially filled. How would you complete it? In the activity with 4-digit numbers we had experienced this already. The idea is to find how the filled in part is arranged and use the same idea to complete the rest.

6.3.1 Sudoku

Sudoku is a number game. Completion with some constraints is best enjoyed in Sudoku. This is a puzzle where there is a partially filled in grid. Horizontal lines of cells in the grid are called as rows and vertical lines of cells in the grid are called as columns. In 9x9 Sudoku, you have to fill in the remaining blank cells with numbers from 1 to 9 so that no number repeats in a row, or in a column. In 3x3 Sudoku, you can use only the numbers from 1 to 3. In 4x4 Sudoku, you can use only the numbers from 1 to 4 and so on.

(i) 3X3 Sudoku

1	2	3
2	3	1

(a)

1	2	3
2	3	1
3	1	2

(b)

Fig. 6.8

DO YOU KNOW?

Sudoku

The word Sudoku comes from the Japanese language. Su means 'number' and Doku means 'single'. It refers to the condition that each number is listed only once in each row, column. The modern version of this puzzle is said to have come from Howard Garns.

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In Fig, 6.8 (a) two rows are fixed. We get only one possible way to complete the third row (Fig. 6.8 (b)).

(ii) 3X3 sudoku

1	2	3

Fig. 6.9

In the above 3 x 3 sudoku, the first row only is fixed. The second row can be filled in 2 ways either by 2 3 1 or 3 1 2

1	2	3
2	3	1
3	1	2

(a)

1	2	3
3	1	2
2	3	1

(b)

Fig. 6.10

To fill the third row, bear in mind that numbers cannot be repeated in the row or in the column. The third row can be filled by only one way in each case.

(iii) 3 × 3 sudoku

In how many different ways can the first row be arranged?

The first row can be arranged in six ways as (1,2,3), (1,3,2), (2,1,3), (2,3,1), (3,1,2) and (3,2,1).

(iv) Let us find all possible solutions to solve 3 × 3 sudoku puzzle.

1	2	3
2	3	1
3	1	2

(a)

1	2	3
3	1	2
2	3	1

(b)

2	3	1
3	1	2
1	2	3

(c)

2	3	1
1	2	3
3	1	2

(d)

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1	3	2
3	2	1
2	1	3

(e)

1	3	2
2	1	3
3	2	1

(f)

3	2	1
2	1	3
1	3	2

(g)

3	2	1
1	3	2
2	1	3

(h)

2	1	3
1	3	2
3	2	1

(i)

2	1	3
3	2	1
1	3	2

(j)

3	1	2
1	2	3
2	3	1

(k)

3	1	2
2	3	1
1	2	3

(l)

Fig. 6.11

We get 12 possible ways.

(iv) Here is a partially filled 4x4 sudoku.

1	4	3	
3			4
	1	2	
2		4	1

Fig. 6.12

One way of completing it is given below. Is there any other way to complete the sudoku?

1	4	3	2
3	2	1	4
4	1	2	3
2	3	4	1

Fig. 6.13

In the 4 × 4 Sudoku, there is an extra condition. We have four 2 × 2 grid boxes in the 4 × 4 sudoku. You have to be careful that no number from 1 to 4 repeats within that 2 × 2 grid also.

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6.3.2 Magic triangle

Magic triangles are also very interesting in a similar way.

In a magic triangle, numbers are to be filled without repetition on the sides of a triangle. So that the sum of each side remains the same.

Fill up the circle with the numbers from 1 to 6 without repetition so that each side of the magic triangle adds upto 12.

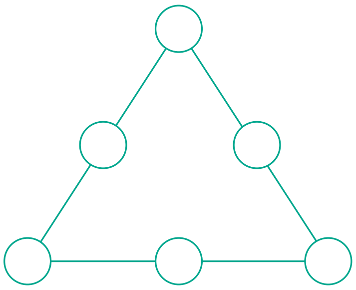

Fig. 6.14

Step 1: Place the larger numbers at the corners of the triangle i.e., 4 ,5, and 6.

Step 2: Place the smaller numbers i.e., 1,2 and 3 in the middle of each side.

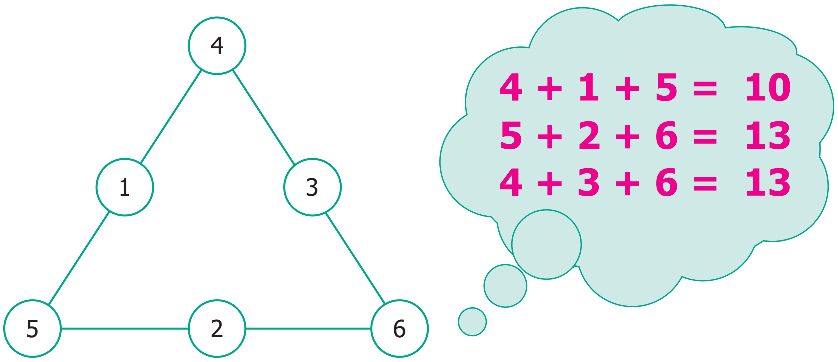

Fig. 6.15

Wrong Placement of numbers (first row 4, second row 1, 3 and third row 5, 2, 6)

Sum of the numbers on three sides of the triangle are 10, 13 and 13. All the total are not the same. This placement of numbers is not correct.

Try the other way, by changing the numbers as shown in the figure, given below.

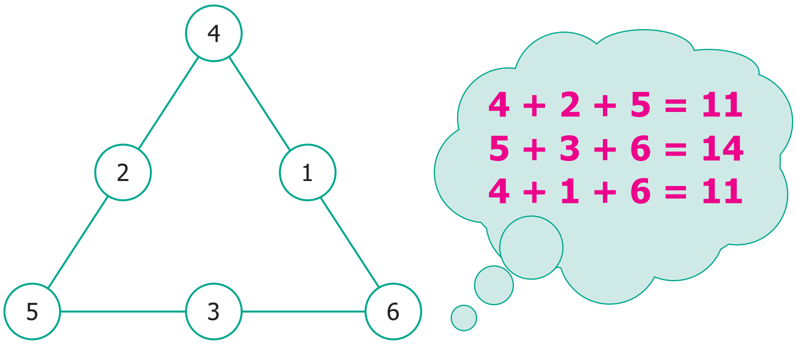

Fig. 6.16

Wrong Placement of numbers (first row 4, second row 2, 1 and third row 5, 3, 6)

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Sums of the numbers on three sides of the triangle are 11, 14 and 11. Again, the totals are not the same.

Try again. Change the numbers to get a total of 12 on each side.

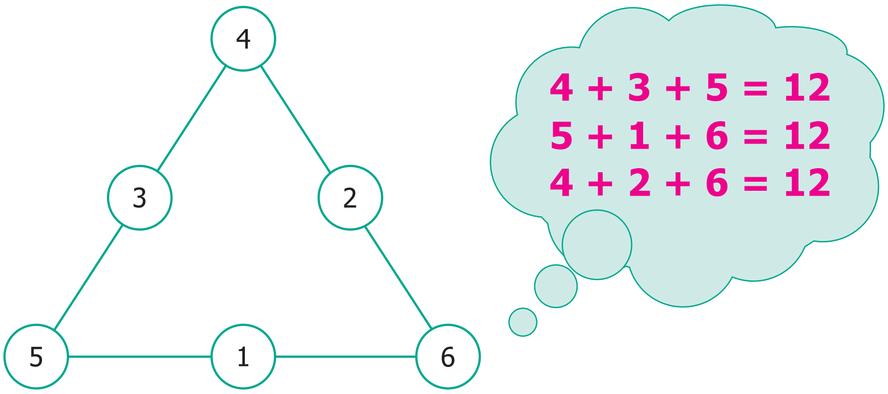


Fig. 6.17

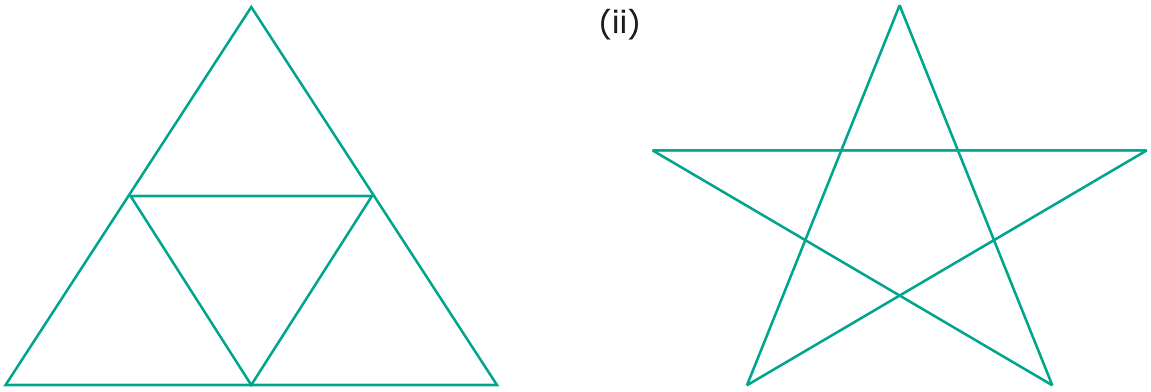
Correct placement of numbers. (first row 4, second row 3, 2 and third row 5, 1, 6) This is the desired magic triangle.

6.3.3 More figures in a figure

Examples

How many triangles are there in the given figures?

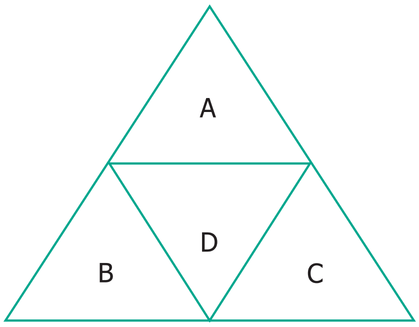
(i) (ii)



(a) (b)

Fig. 6.18

(i) Solution



(a)

A, B, C, D are four triangles.

Combining A & D, B & D and D & C do not form any triangles.

Combining A, B & D; A, C & D and B, D & C also do not form any triangles.

Combining A, B, C & D = 1 triangle

$\therefore$ Total number of triangles = 4 + 1 = 5

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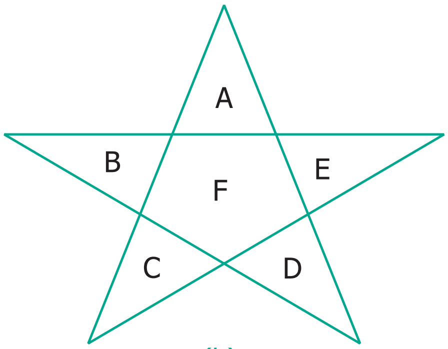
(ii) Solution



(b)

A, B, C, D, & E are five triangles.

No combination of these triangles taken 2 at a time, form any triangle.

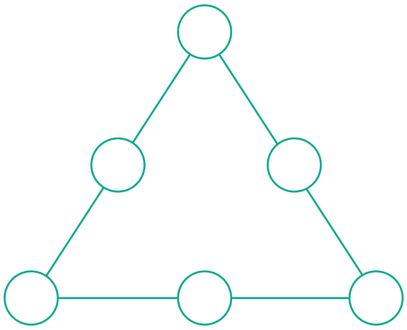
Only the combinations of A, F & C; A, F & D; B, F & E; B, F & D and C, F & E form triangles when taken 3 triangles at a time. Hence, the total number of triangles = 5 + 5 = 10.

Exercise 6.1

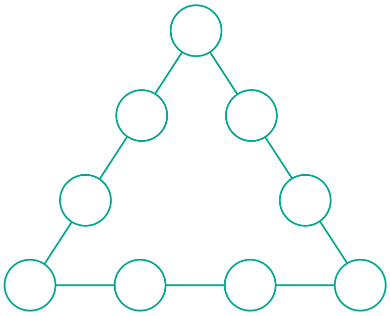
1. Suppose, you have two shorts, one is black and the other one is blue; three shirts which are in white, blue and red. You again wish to make different combinations, but you always want to make sure that the shorts and shirt that you wear are of different colours. List and check how many combinations are possible now.

2. You have two red and two blue blocks. How many different towers can you build that are four blocks high using these blocks? List all the possibilities.

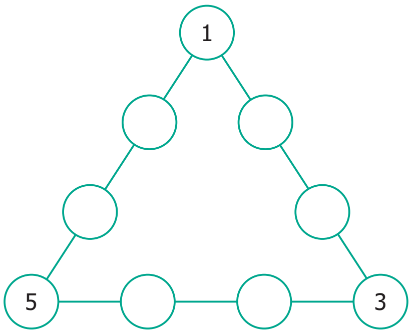
3. In the following magic triangle, arrange the numbers from 1 to 6, so that you get the same sum on all its sides.



4. Using the numbers from 1 to 9
   (i) Can you form a magic triangle?
   (ii) How many magic triangles can be formed?
   (iii) What are the sums of the sides of the magic triangle?



5. Arrange the odd numbers from 1 to 17 without repetition to get a sum of 30 on each side of the magic triangle.



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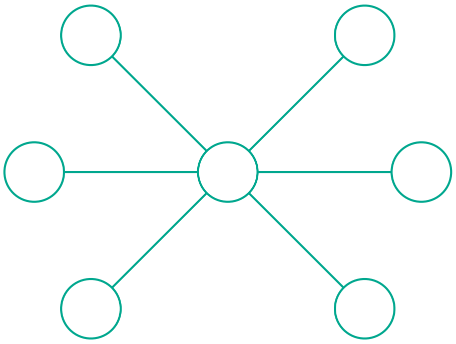
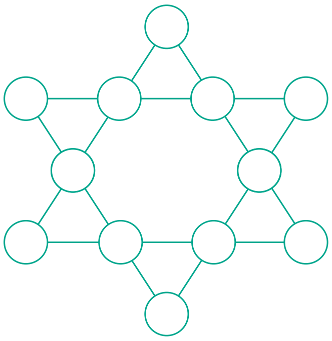
6. Put the numbers 1, 2, 3, 4, 5, 6, & 7 in the circles so that each straight line of three numbers add up to the same total.

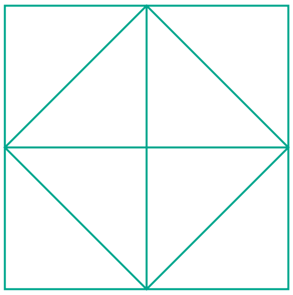


7. Place the number 1 to 12 in the 12 circles so that the sum of the numbers in each of the six lines of the star is 26. Use each number from 1 to 12 exactly once. Find more possible ways?



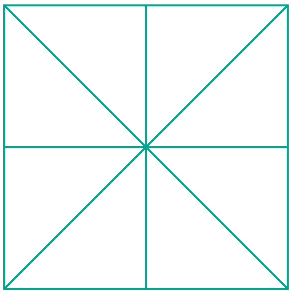
8. How many Triangles are there in each of the following figures?

(i)



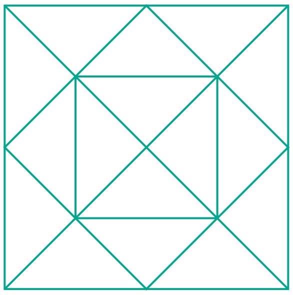
(a)

(ii)



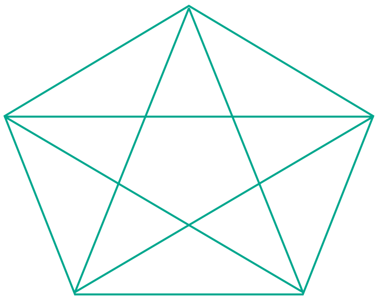
(b)

(iii)



(c)

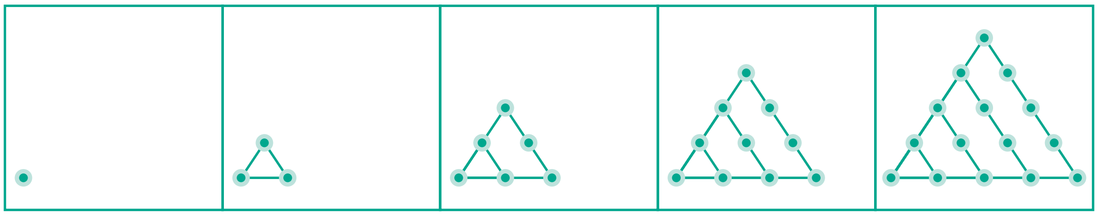
(iv)



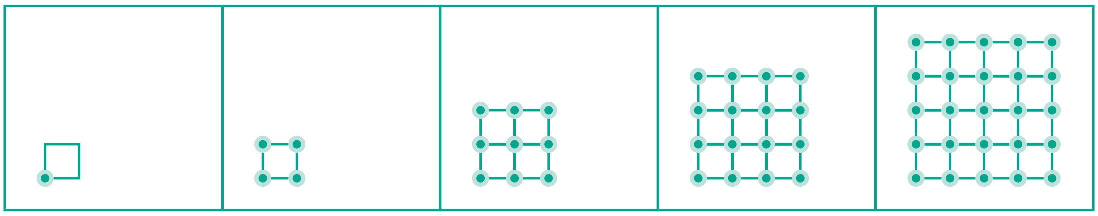
(d)

9. Find the number of dots in the tenth figure of the following patterns.

(i)



(ii)



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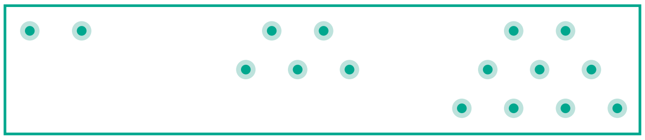
10. 

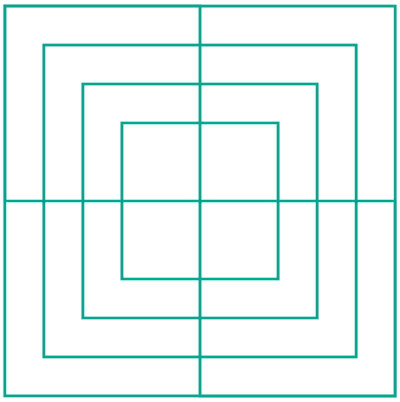
(i) Draw the next pattern.

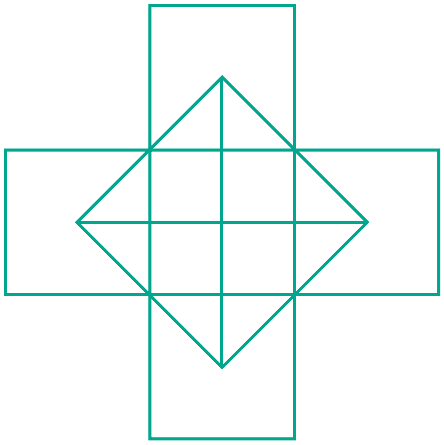
(ii) Prepare a table for the number of dots used for each pattern.

(iii) Explain the pattern.

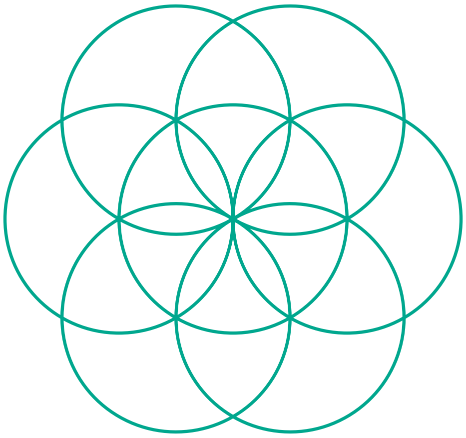
(iv) Find the number of dots in the 25th pattern.

11. Count the number of squares in each of the following figures?

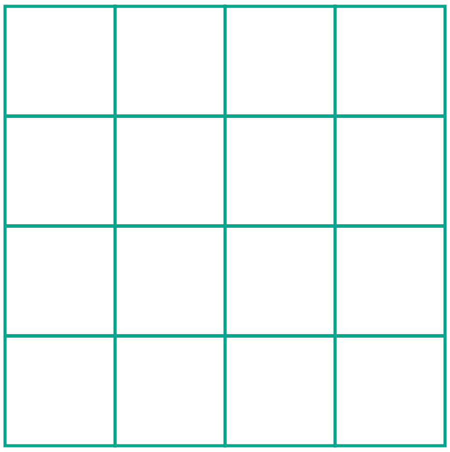
(i) 

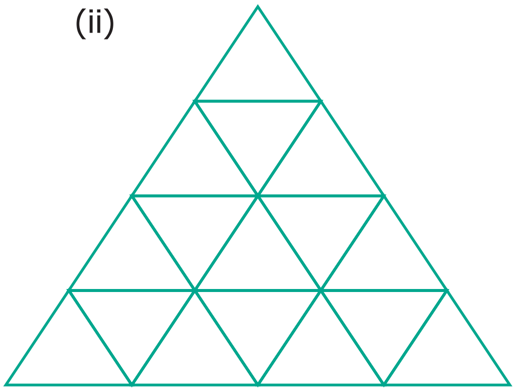
(ii) 

12. How many Circles are there in the following figure?



13. Find the minimum number of straight lines used in forming the following figures.

(i) 

(ii) 

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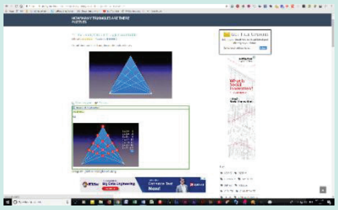
ICT Corner

INFORMATION PROCESSING

Expected Result is shown in this picture



Step – 1

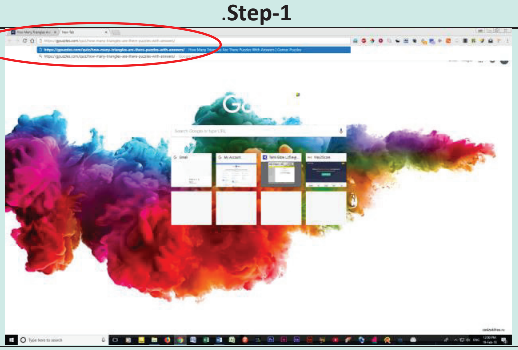
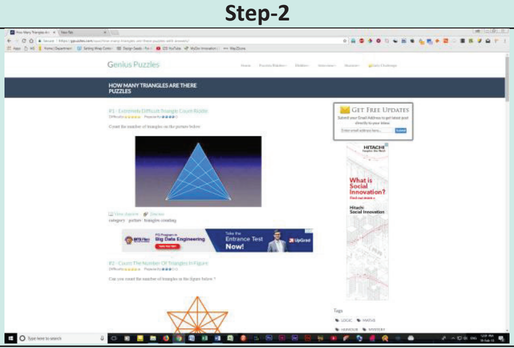
Open the Browser, copy and paste the link given below (or) by type the URL given (or) Scan the QR Code.

Step - 2

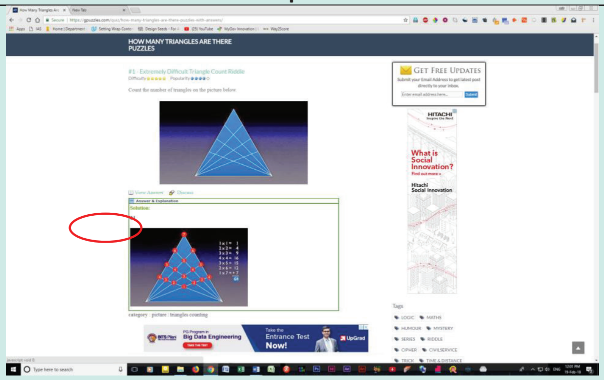
"Genius Puzzles" web page will appear. There are many PUZZLES related to the triangle are present. This page is to find "HOW MANY TRIANGLES ARE THERE" in the given figure.

Step-3

Calculate your answer and click "View Answer" to check whether your answer is correct for each puzzle.

.Step-1	Step-2
	

Step-3



Browse in the link

Triangles: https://gpuzzles.com/quiz/how-many-triangles-are-there-puzzles-with-answers/

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ANSWERS

NUMBERS

Exercise 1.1

1) (i) 10,00,000 (ii) 9,99,99,999 (iii) Five Thousand (iv) 7000000+600000+70000+900+5

2) (i) False (ii) False (iii) True (iv) False

3) 10 4) (i) 70,00,000 (ii) 7,000,000

5) (i) 347,056 (ii) 7,345,671 (iii) 634,567,105 (iv) 1,234,567,890

6) Indian System : 9,99,999 (Nine Lakh Ninety Nine Thousand Nine Hundred Ninety Nine)
International System : 999,999 (Nine Hundred Ninety Nine Thousand, Nine Hundred Nintey Nine)

7) (i) Seventy five lakh thirty two thousand one hundred five

(ii) Nine crore seventy five lakh sixty three thousand four hundred fifty three

8) (i) Three hundred forty five thousand six hundred seventy eight

(ii) Eight million three hundred forty three thousand seven hundred ten

iii) One hundred three million four hundred fifty six thousand seven hundred eighty nine

9) (i) 2,30,51,980 (ii) 66,345,027 (iii) 789,213,456 10) 26,345

11) 1,000,000 (One million)

Objective Type Questions

12) (b) 10000001 13) (c) 2 14) (a) 100 Crore

15) (d) 6× 100000 + 7 × 10000 +0× 1000 +9× 100 +0× 10 +5× 1

Exercise 1.2

1) (i) 48792< 48972 (ii) 1248654> 1246854 (iii) 658794 = 658794

2) (i) False (ii) False (iii) True

3) The greatest number is 1386787215
The smallest number is 86720560

4) 128435 > 25840 > 21354 > 10835 > 6348

5) 76095321, 86593214 (Similarly, we can write many numbers)

6) 479, 497, 749, 794, 947, 974 7) 4698

8) The smallest Postal Index Number is 631036
The largest Postal Index Number is 631630

9) (i) Aanaimudi (ii) Aanaimudi > Dottabetta > Velliangiri > Mahendragiri
(iii) 1048 m

Objective Type Questions

10) (c) 134205, 134208, 154203 11) (a) 1489000 and 1492540 12) (d) 26

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Exercise 1.3

1) (i) 360 (ii) 150 (iii) 1 2) (i) False (ii) True (iii) False 3) 11910

4) 2,15,750 5) 39,000 bicycles 6) ` 2500 7) (i) 9 (ii) 11 (ii) 107

8) (d) 1 9) (b) 12 10) (c) ×

Exercise 1.4

1) (i) 800 (ii) 1000 (iii) 90,000 2) (i) False (ii) True (iii) False

3) (i) 4100 (ii) 45,000 (iii) 90,000 (iv) 51,00,000 (v) 30,00,00,000

4) 1,90,000 5) (i) 12,300 (ii) 18,99,600 6) 3,37,000

Objective Type Questions

7) (b) 10855 8) (c) 76800 9) (a) 9800000 10) (b) 165000

Exercise 1.5

1) (i) 1 (ii) 34 (iii) 0 (iv) Zero (v) one

2) (i) False (ii) False (iii) True (iv) True (v) True

3) (i) Commutativity for Addition (ii) Associativity for Multiplication
(iii) Zero is Additive Identity (iv) One is Multiplicative Identity
(v) Distributivity of Multiplication over Addition

4) (i) 5100 (ii) 3,00,000 (iii) 13,200 (iv) 334

Objective Type Questions

5) (b) 0 6) (d) 59 7) (a) an even number

8) (b) 0 9) (c) 2+0 10) (c) $4237 + 5498 \times 3439 = (4237 + 5498) \times 3439$

Exercise 1.6

1) 87543

2) Ascending Order : 6,85,48,437 < 7,21,47,030 < 7,26,26,809 < 9,12,76,115
Descending Order: 9,12,76,115 >7,26,26,809 >7,21,47,030 > 6,85,48,437

3) (i) 1706 tigers in 2011 (ii) 2100 (iii) 520 tigers increased from 2011 to 2014

4) among 6 friends, each of them get 37 apples. 3 apples left over

5) 515 + 1 = 516 trays required

6) (i) Indian System:Two crore fifty nine lakh forty one thousand nine hundred
International System : Twenty five million nine hundred forty one thousand nine hundred
(ii) 5,50,500 (iii) Eighty six crore forty lakh seven hundred thirty
(iv) Ninteen million eight hundred eighty eight thousand eight hundred
(v) Indian System : 60,53,100 - Sixty lakh fifty three thousand one hundred
International System : 6,053,100 - Six million fifty three thousand one hundred

7) One of the answers is 43781. Many answers are possible

8) (i) 85 rows are required to fill 7650 chairs (ii) The remaining chairs are 39

9) Yes, both are same (30,00,000) 10) Relevant answers are yours

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ALGEBRA

Exercise 2.1

1) (i) Variables (ii) f - 5 (iii) $\frac{s}{5}$ (iv) n - 7 (v) 17

2) (i) False (ii) True (iii) False (iv) True (v) True

3)

Shapes	1st Pattern	2nd Pattern	3rd Pattern	4th Pattern	5th Pattern
Squares	1	2	3	4	5
Circles	1	2	3	4	5
Triangles	2	4	6	8	10

4) Arivazhagan's age is 'n-30' 5) (i) u + 2 (ii) u – 2

6) (i) t + 100 (ii) 4q (iii) 9y - 4

7) (i) x divided by 3 (ii) 11 added to 10 times x (iii) product of 70 and s

8) Vetri's answer is correct 9) (i) 299; 301 (ii) 18

10)

k	3	6	9	12	15	18
$\frac{k}{3}$	1	2	3	4	5	6

The value of 'k' is 15.

Objective Type Questions

11) c) can take different values 12) d) 7w 13) d) 22

14) b) y = 6 15) a) n - 6 = 8

Exercise 2.2

1) 8; 77; 666; 5555; 44444; 333333 2) (i) 4s (ii) 3s

3)

8	7	7	8	=30
8	8	10	10	=36
8	10	7	7	=32
8	7	10	7	=32
=32	=32	=34	=32	=130

4) k = 3; m = 1; n = 10; a = 9; b = 6; c = 4; x = 4; y = 9.

5) 19

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6) (i) P=2; Q=8; R=6; S=10

(ii)

Rectangle	P	Q	R	S	T
Number of squares along the breadth	2	2	2	2	2
Number of squares along the length	1	4	3	5	x
Total number of squares in rectangle	2	8	6	10	2x

7)

x 6	0 0		t 3	8	
0		z 2	5		p 9
v 3	6	5		k 4	9
0			u 2	4	
		a 6	0		m 1
	s 2	4	7		0

RATIO AND PROPORTION

Exercise 3.1

1) (i) 3 : 5 (ii) 3 : 2 (iii)25 : 2 (iv)3 : 8 2) (i) True (ii) False

3) (i) 3 : 4 (ii) 4 : 3 (iii) 7 : 15 (iv) 4 : 9 (v) 3 : 4 4) 5 : 3 5) 1 : 3

6) (i) 3 : 5 (ii)2 : 5 (iii)3 : 2 7) (d) 5 : 1 8) (c) 20 : 1 9) (d) 10 : 7

10. (b) 3 : 4 11. (c) 5 : 1

Exercise 3.2

1) (i) 15 (ii) 8 (iii) 12 2) (i) 36 inches, 6 Feet (ii) 14 days, 9 weeks

3) (i) False (ii) True 4) (i) 6 : 4, 9 : 6 (ii) 2 : 12, 3 : 18 (iii) 10 : 8, 15 : 12

5) (i) 4 : 5 is larger than 8 : 15 (ii) 7 : 8 is larger 3 : 4 (iii) 2 : 1 is larger than 1 : 2

6) (i) 12, 8 (ii) 12, 15 (iii) 12, 28 7) (i) Rs.2400 (ii) Rs.1600

8) 21 cm, 42 cm 9) (a) 6 10) (d) 12 : 21 11) (d) 20/28 12) (c) Rs.1000

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Exercise 3.3

1) (i) 12 (ii) 9 (iii) 4; 12 (iv) 24; 2 2) (i) False (ii) False (iii) True (iv) False

3) (i) Rs.30 (ii) 25 days 4) Yes, 12:24, 18:36

5) (i) Yes, Extreme values - 78, 20; Inbetween values - 130, 12

(ii) No, Extreme values - 400, 625; Inbetween values - 50, 25

6) Yes 7) 80 Pages 8) 2 km 9) 44 points

10) Asif's run rate is better 11) My friend's rate of purchase is better than me.

Objective Type Questions

12) (c) 2 : 5 , 10 : 25 13) (d) 8 14) (c) 35 15) (b) 270 16) (c) 6 km

Exercise 3.4

1) (i) 1 : 4 (ii) 4 : 5 (iii) 1 : 5 (iv) Ratio of elephant to cheetah is least

2) 60 teachers and 6 administrators 3) (i) 2 : 1 (ii) 1 : 3 (iii) 12 ratios

4) A : B = 2 : 1, B : C = 2 : 1; They are in proportion.

5) (a) $\frac{1}{4}$ cup (b) 8 cups

(c) Ragi flour, Raw rice and water are in one unit, Sesame oil and salt are in different units. these different units cannot be compared and cannot be expressed as a ratio.

6) 2 : 1 7) There are four different ways. 8) Team B has better record

9) The standard 8 is the least ratio

10) The six different answers are : 1 and 90; 2 and 45; 30 and 3; 5 and 18; 6 and 15, 9 and 10.

11) 29 : 44 12) (a) Black balls (b) 96 balls (c) 32 balls, 24 balls

GEOMETRY

Exercise 4.1

1) i) $\overleftrightarrow{AB}$ ii) $\overline{BA}$ iii) One 2) 10, $\overline{PQ}$, $\overline{PA}$, $\overline{PB}$, $\overline{PC}$, $\overline{AB}$, $\overline{BC}$, $\overline{CQ}$, $\overline{AQ}$, $\overline{BQ}$, $\overline{AC}$

3) $\overline{XY}$ =2.4 cm, $\overline{AB}$ = 3.4cm, $\overline{EF}$ = 4 cm, $\overline{PQ}$ = 3cm.

5) (i) $\overleftrightarrow{CD}$ and $\overleftrightarrow{EF}$, $\overleftrightarrow{CD}$ and $\overleftrightarrow{IJ}$, $\overleftrightarrow{EF}$ and $\overleftrightarrow{IJ}$

(ii) $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$, $\overleftrightarrow{AB}$ and $\overleftrightarrow{EF}$, $\overleftrightarrow{AB}$ and $\overleftrightarrow{IJ}$, $\overleftrightarrow{GH}$ and $\overleftrightarrow{IJ}$, $\overleftrightarrow{AB}$ and $\overleftrightarrow{GH}$ (iii) P, Q and R

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6) (i) l_3 and l_4 , l_4 and l_5 , l_3 and l_5

(ii) l_1 and l_2, l_1 and l_3 , l_1 and l_4 , l_1 and l_5, l_2 and l_3 , l_2 and l_4 , l_2 and l_5

(iii) l_1 and l_2 (iv) Q (v) U

Objective Type Questions

7) c) 3 8) d) $\overline{AB}$

Exercise 4.2

2) i) D, $\overrightarrow{DE}$ and $\overrightarrow{DF}$ ii) D, $\overrightarrow{DE}$, $\overrightarrow{DC}$

3) i), iii), v) are right angles 4) i), ii) and iii) are acute angles

5) i), iii) are obtuse angles

6) i) ∠LMN, ∠NML, ∠M ii) ∠PQR, ∠RQP, ∠Q

iii) ∠MNO, ∠ONM, ∠N iv) ∠TAS, ∠SAT, ∠A

7) i) True ii) False iii) False iv) True

9) i) Obtuse angle ii) Zero angle iii) Straight angle iv) Acute angle v) Right angle

10) i) 60° ii) 64° iii) 5° iv) 90° v) 0°

11) i) 110° ii) 145° iii) 15° iv) 90° v) 180°

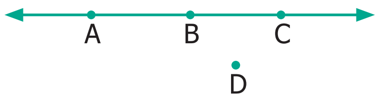
12) i) 155° ii) 60° iii) 44° iv) 113° 13) b) ∠ZXY 14) b) 45°

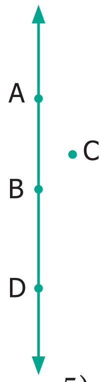
Exercise 4.3

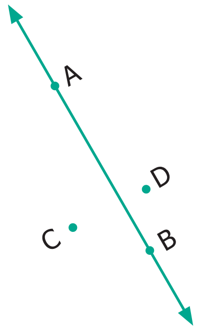
1) i) Collinear ii) Non-Collinear iii) Non-Collinear iv) O

2)

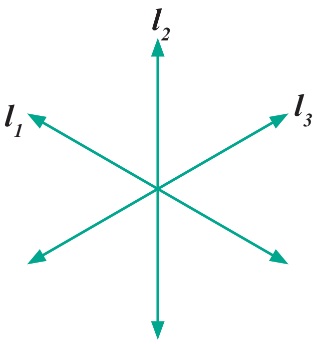
3)







4)



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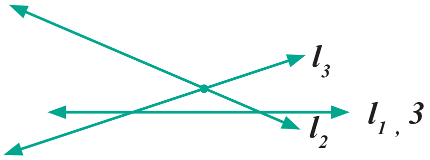

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Objective Type Questions

6) b) A, F, C 7) d) A, D, C 8) b) F

Exercise 4.4

1) i) Parallel lines ii) Parallel and Perpendicular lines

iii) Intersecting lines

2)

Parallel lines	Intersecting Lines
$\overline{AB}$ and $\overline{DC}$	$\overline{AB}$, $\overline{AE}$, $\overline{AD}$
$\overline{AD}$ and $\overline{BC}$	$\overline{DA}$, $\overline{DH}$, $\overline{DC}$
$\overline{DC}$ and $\overline{HG}$	$\overline{CB}$, $\overline{CG}$, $\overline{CD}$
$\overline{AD}$ and $\overline{EH}$	$\overline{HD}$, $\overline{HG}$, $\overline{HE}$
$\overline{AE}$ and $\overline{DH}$	$\overline{EA}$, $\overline{EH}$...
$\overline{DH}$ and $\overline{CG}$	

3) i) $\angle 1 = \angle CBD$ or $\angle DBC$ ii) $\angle 2 = \angle DBE$ or $\angle EBD$

iii) $\angle 3 = \angle ABE$ or $\angle EBA$ iv) $\angle 1 + \angle 2 = \angle CBE$ or $\angle EBC$

v) $\angle 2 + \angle 3 = \angle ABD$ or $\angle DBA$ vi) $\angle 1 + \angle 2 + \angle 3 = \angle ABC$ or $\angle CBA$

4) i) right angle ii) acute angle iii) straight angle iv) obtuse angle

5) (i) and (iv) are complementary angles (ii) and (iii) are non-complementary angles

6) ii) and iv) are supplementary i) and iii) are not supplementary

7) i) $\angle FAE$; $\angle EAD$

ii) $\angle FAD$; $\angle DAC$ $\angle BAC$; $\angle CAE$ $\angle DAB$; $\angle DAE$ $\angle FAB$; $\angle BAC$ $\angle FAB$; $\angle FAE$

8) i) Legs of the table, railway track, edges of the scale

ii) Adjacent sides of a Board, Cross bars of windows, Adjacent sides of the textbook

iii) Cross bars of windows, Ladder, blades of a scissor.

9) 60° is twice its complement. 10) 72° 11) The two angles are 80° and 100°

12) Two angles are 70° and 20°. 13) The angles are 100° and 80°.

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STATISTICS

Exercise 5.1

1) (i) Data (ii) List of absentees in a class

(iii) Cricket scores gathered from a website (iv) 卌 |||

2)

Face of die	Tally Marks	Frequency
1	|||	3
2	||	2
3	||	2
4	卌 |	6
5	卌 ||||	9
6	卌 |||	8
		30

3)

Colours	Tally Marks	Frequency
Red	||||	4
Blue	卌 |	6
White	||	2
Grey	卌 ||	7
Green	卌 |	6
		25

4)

Numbers	Tally Marks	Frequency
11	||	2
12	卌	5
13	||||	4
14	||||	4
15	卌 |	6
16	||||	4
17	||	2
18	|	1
19	|	1
20	|	1
		30

5)

Types of Calls	Tally Marks	Frequency
Building fires	卌 |	6
Other fires	卌 卌 |	11
Hazardous materials	卌 ||	7
Rescues	||||	4
False Alarms	卌 ||	7
		35

(i) Other fires (ii) Rescues (iii) 35 (iv) 7

6) (b) 卌 || 7) (c) 9

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Exercise 5.2

1) i) 150 ii) iii) Pictograph

4) i) kabaddi ii) 110 iii) Kho-Kho and Hockey iv) 0 v) Basketball

5) (c) Scaling 6) (b) Pictogram

Exercise 5.3

1) i) 10 ii) Mathematics iii) Language iv) 65% v) English
vi) Mathematics; English

5) (d) Both horizontal bars or vertical bars. 6) (b) are the same

Exercise 5.4

Heights (in Cms)	Tally Marks	Frequency
110	卌	5
111	卌 |||	8
112						4
113	卌	5
114				2
115						4
116					3
117		
118				2
119			1
120	卌		6
		40

2) i) 5 : 4 ii) 5 : 19 iii) ` 300 iv) ` 2400 v) true

4) ii) 14 days iii) 24 days iv) 5 : 3

7) i) Novelists ii) Scientists iii) Sportspersons iv) 25 v) 160

INFORMATION PROCESSING

Exercise 6.1

1) 5 combinations are possible, Black - White, Black - Blue, Black - Red, Blue - white, Blue - Red

2) 6 possibilities, R - B - R - B, R - R - B - B, B - R - R - B, B - R - B - R, B - B - R - R, R - B - B - R

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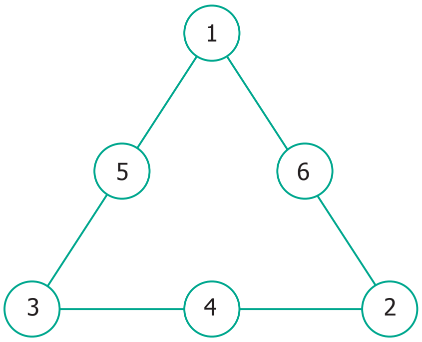
(3) One of the answers is,

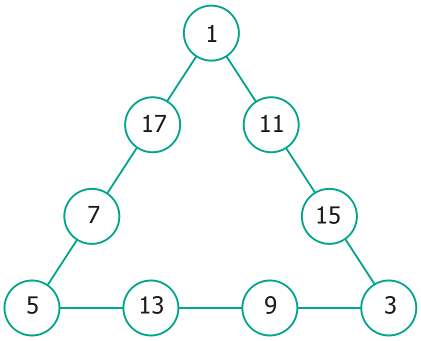


(4) (i) Yes

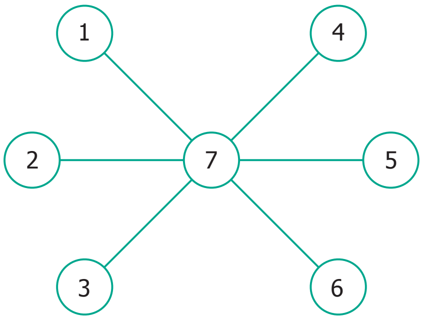
(ii) 5

(iii) 17, 19, 20, 21, 23

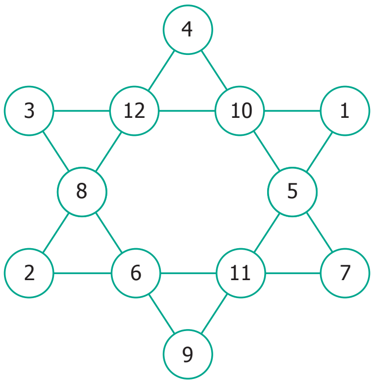
5)



6)



(7) There are many other possible ways.



(8) (i) 12 triangles

(ii) 16 triangles

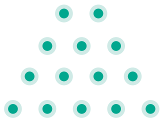
(iii) 32 triangles

(iv) 35 triangles

(9) (i) 55

(ii) 100

(10) (i)



(ii)

Pattern	1	2	3	4
Number of dots	2	5	9	14

(iii)

Pattern	1	2	3	4
Number of dots	2	2 + 3	2 + 3 + 4	2 + 3 + 4 + 5

(iv) 350

(11) (i) 20 squares (ii) 10 squares

(12) 7 circles (13) (i) 10 (ii) 12

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MATHEMATICAL TERMS

Acute angle	குறுங்கோணம்	Operation on Variables	மாறிகள் மீதான செயல்பாடு
Additive Identity	கூட்டல் சமனி	Organizing data	தரவு ஒருங்கமைப்பு
Algebra	இயற்கணிதம்	Parallel lines	இணை கோடுகள்
Algebraic Expressions	இயற்கணித கோவைகள்	Pictograph	உருவ விளக்கப்படம்
Algebraic Statement	இயற்கணித கூற்று	Place Value Chart	இடமதிப்பு அட்டவணை
Angle	கோணம்	Plane	தளம்
Associative	சேர்ப்பு	Point of Intersection	வெட்டும் புள்ளி
Bar graph	பட்டை வரைபடம்	Points	புள்ளிகள்
Classification	வகைப்படுத்துதல்	Points of concurrency	ஒருங்கமை புள்ளிகள்
Closure	அடைவு	Predecessor	முன்னி
Coincide	ஒன்றுதல்	Primary data	முதன்மை தரவு
Collecting data	தரவு திரட்டுதல்	Product	பெருக்கற்பலன்
Collinear points	ஒரு கோடமை புள்ளிகள்	Properties	பண்புகள்
Commutative	பரிமாற்று	Proportion	விகித சமம்
Complementary angles	நிரப்புக் கோணங்கள்	Proportionality law	விகித சம விதி
Construction	வரைமுறை	Protractor	பாகைமானி
Data/Information	தரவு / தகவல்	Quotient	ஈவு
Denominator	பகுதி	Ratio	விகிதம்
Discrete	தொடர்ச்சியற்ற	Rays	கதிர்கள்
Distributive	பங்கீட்டு	Right angle	செங்கோணம்
Equation	சமன்பாடு	Rounding off	முழுமையாக்கல்
Equivalent Ratio	சமான விகிதம்	Scaling	அளவுத்திட்டம்
Estimation	மதிப்பீடு	Secondary data	இரண்டாம் நிலைத் தரவு
Expanded form	விரிவாக்கம்	Sequence	தொடர்கள்
Facts	உண்மைகள்	Set Square	முக்கோணமானிகள்
First hand information	முதல்நிலை தரவு	Shaded portion	நிழலிடப்பட்டபகுதி
Fractions	பின்னங்கள்	Solve	தீர்வு காணல்
Frequency	நிகழ்வெண்	Standard form	திட்ட வடிவம்
Geometry	வடிவியல்	Statistics	புள்ளியியல்
Horizontal bars	கிடைமட்ட பட்டைகள்	Straight angle	நேர்கோணம்
Information Processing	தகவல் செயலாக்கம்	Successor	தொடரி
Integers	முழுக்கள்	Sudoku	சுடோகு
Interchanging Digits	இலக்கங்களின் இடமாற்றம்	Supplementary angles	மிகை நிரப்புக் கோணங்கள்
Intersecting lines	வெட்டும் கோடுகள்	Systematic listing	முறையான பட்டியல்
Interpret	விவரித்தல்	Tabulation	பட்டியலிடுதல்
Line segment	கோட்டுத்துண்டு	Tally mark	நேர்கோட்டு குறிகள்
Lines	கோடுகள்	Unitary method	அலகு முறை
Magic triangle	மாய முக்கோணம்	Unshaded portion	நிழலிடப்படாத பகுதி
Measure	அளவீடு	Variables	மாறிகள்
Multiplicative identity	பெருக்கல் சமனி	Variation	மாறல்
Natural Numbers	இயல் எண்கள்	Verbal statements	சொற்றொடர் கூற்று
Notation	குறியீடு	Vertex	முனை
Number patterns	எண் அமைப்புகள்	Vertical bars	செங்குத்து பட்டைகள்
Numerator	தொகுதி	Vice-versa	மறுதலை
Obtuse angle	விரிகோணம்	Whole Numbers	முழு எண்கள்

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